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SATURN SA-7/BP-15 POSTFLIGHT TRAJECTORY

by GERALD R. RIDDLE AND ROBERT H. BENSON
Aero-Astroynamics Laboratory

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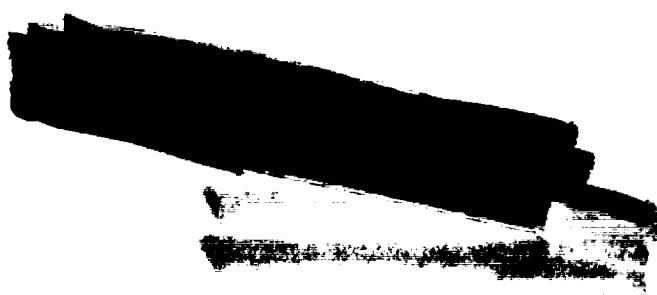
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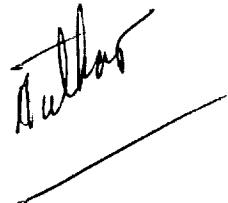
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ABSTRACT

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This report presents the postflight trajectory for the Saturn SA-7/BP-15 test flight. Third of the Block II series, SA-7 was the second of the Saturn class vehicles to carry an Apollo boilerplate, BP-15, payload. Trajectory dependent parameters are given in earth-fixed, space-fixed ephemeris, and geographic coordinate systems. A complete time history of the powered flight trajectory is presented at 1.0 sec intervals from S-I/S-IV separation to insertion. Tables of insertion conditions and various orbital parameters are included in a discussion of the orbital portion of flight.


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Flight Evaluation and Operations Studies Division
AERO-ASTRODYNAMICS LABORATORY

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SATURN SA-7/BP-15 POSTFLIGHT TRAJECTORY

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SUMMARY

The powered flight trajectory as presented in Tables X through XIV and XVI through XX was established from the information provided by external electrical tracking systems, external optical tracking systems, and the onboard telemetry system. The data from the various tracking systems were analyzed by components to determine reliability and consistency. During the liftoff phase of flight the cameras were the only tracking systems to provide good coverage. Immediately after the liftoff phase the ODOP, Azusa, MISTRAM, and some of the various radars located in the vicinity of the launch area began to acquire reliable data. The MISTRAM system acquired more reliable data than any other external tracking system. All of the radars provided consistent, reliable range data; however, some of the azimuth and elevation measurements were inconsistent.

SA-7/BP-15 was the fourth engineering test of the radar altimeter. The altimeter acquired reliable data from approximately 160 to 800 sec. The data were more continuous than on SA-4, SA-5, and SA-6.

A theoretical freeflight trajectory of the separated S-I booster was computed using Patrick (0.18) radar information to determine initial conditions. The impact, assuming the booster remained intact, was at a longitude of 72.062 deg W and a latitude of 26.094 deg N.

The S-IV payload at orbital insertion (631.375 sec) had a space-fixed velocity 2.8 m/s (9.2 ft/s) greater than nominal, a perigee altitude of 180.21 km (97.31 nm) and an apogee altitude of 234.10 km (126.40 nm), giving an actual lifetime of 3.8 days, 0.6 days longer than nominal. The extrapolated orbit based on data for an epoch of 10:57 Z Sept 22 reached the estimated breakup altitude of 86 km (46.4 nm) at approximately 11:50 Z Sept 22, at coordinates of 21.7 deg S latitude and 56.4 deg E longitude. The theoretical ballistic impact time was approximately 12:00 Z Sept 22, at coordinates of 26.4 deg S latitude and 69.0 deg E longitude.

1.0 INTRODUCTION

The SA-7 Saturn vehicle was launched from Cape Kennedy on September 18, 1964, at 11:22:43 Eastern Standard Time. Approximately 10 min and 31 sec after launch, the S-IV stage with instrument unit and Apollo boilerplate was inserted into orbit.

SA-7 was the third flight test of the Saturn I, Block II vehicle, which includes an active S-IV stage. This was the second flight test with an unmanned boilerplate Apollo Spacecraft, BP-15. In addition, this was the second flight test with the adaptive guidance in closed loop during the S-IV powered flight phase.

This report presents the postflight mass point trajectory in tabular form from first motion to insertion in Tables X through XIV and XVI through XX. Also presented are detailed discussions of data sources and their utilization, estimated accuracies of the trajectory, and the booster freeflight trajectory. A table of orbital data utilization and orbital tracking residuals is included in the discussion of the orbital portion of flight. An analysis of the various orbital tracking networks is also presented.

All times listed in the tables are referenced to Range Zero (11:22:43 EST), unless otherwise noted. The time of first motion was defined as occurring 0.06 sec after Range Zero.

Acknowledgement is given to the Data Reduction Branch of the Computation Laboratory for their efforts in the preparation of the tabulated trajectory data and to the General Electric Trajectories Programming Unit for programmer support in orbit determination.

2.0 COORDINATE SYSTEMS AND TRAJECTORY PARAMETERS

The translational motion of the vehicle's center of gravity is described in several coordinate systems. An initial displacement of 32.2 m (105.6 ft) locates the center of gravity in the coordinate system whose origin lies on the reference ellipsoid. Definitions of the coordinate systems are found in the Appendix.

The Fischer Ellipsoid was used to represent the earth and its gravitational field. Launch pad coordinates are defined with respect to this ellipsoid.

The geographical coordinates and gravity data for Launch Pad 37B at Cape Kennedy are

Geodetic Latitude:	28.531854°N
Longitude:	80.564953°W
Gravity:	9.818 m/s ² (32.21 ft/s ²)

Elevations above the reference ellipsoid are

Base of launch pedestal:	4.9 m (16.1 ft)
C.G. at First Motion:	32.2 m (105.6 ft)
Launch Azimuth:	90° E of N
Flight Azimuth:	105° E of N
ST-124 Platform Azimuth:	104.992° E of N

3.0 POWERED FLIGHT TRAJECTORY ANALYSIS

3.1 Data Sources

Tracking data were available from first motion through insertion. The tracking coverage is illustrated in Figure 1 and itemized in Table I. The relation between the SA-7 flight path and the various tracking sites is shown in Figure 2.

All tracking systems experienced difficulty in maintaining track during S-I cutoff and separation. The drop in signal strength experienced at approximately 480 sec by all C-Band radars tracking the IU beacon on vehicles SA-5 and SA-6 did not occur on SA-7. All cabling and connectors linking the radar beacon to the antenna were tested under vacuum conditions for voltage breakdown and several components were replaced. This "fix" appears to be satisfactory since no breakdown occurred on the SA-7 flight.

3.1.1 Antenna Locations

Figure 3 shows the location of the antenna for the various tracking systems and the vehicle's center of gravity versus time. The tracking data used in establishing the trajectory were transferred to the vehicle center of gravity to provide a common reference point for all of the tracking systems.

3.1.2 MISTRAM

Missile Trajectory Measurement (MISTRAM) System tracking data were received during the following intervals:

<u>Range Time (sec)</u>	<u>Source</u>
45.00 - 148.10	Valkaria (active)
153.00 - 291.10	
302.95 - 336.70	
153.00 - 349.70	Eleuthera (passive)
352.00 - 580.30	Eleuthera (active)
380.00 - 433.75	Valkaria (passive)

The data were reliable from 50 to 500 sec. Random error was estimated to be less than 5 m (16 ft). Comparisons between MISTRAM and the reference trajectory are presented in Figures 5 through 7.

3.1.3 GLOTRAC

SA-7 was the second engineering test of the GLOTRAC system on a Saturn vehicle. The GLOTRAC system had difficulty with the San Salvador transmitter, so reduced metric data were obtained only from 170 to 403 sec. The random error was estimated to be less than 5 m (16 ft) in position components. The GLOTRAC data are included in the tracking comparisons (Figures 5 through 7).

3.1.4 Radar Altimeter

An engineering test of the radar altimeter was performed on SA-7. According to the altimeter reliability signal, valid data were obtained from 164 to 795 sec with only a few short dropouts. The data were considerably more continuous than on SA-4, SA-5, and SA-6. The random error in the altimeter data was estimated to be 75 m (246 ft). Comparisons of the altimeter output with the reference trajectory and several tracking systems are shown in Figure 4. Only the smoothed trends are shown to avoid confusion. This comparison indicates a possible bias in the altimeter of approximately 100 m (328 ft).

The output of the altimeter was used as a basis for selecting tracking systems utilized in the intermediate and final trajectories. The final trajectory from 500 sec to insertion was determined by the altimeter data and the insertion coordinates.

3.1.5 ODOP

The ODOP system (offset doppler velocity and position) provided the best S-I stage tracking coverage. This was the second test of the ODOP system on the Saturn vehicle. Reduced metric data were received beyond 320 sec but Figures 5 through 7 show that the later data were not valid. The random error was estimated to be less than 2 m (6.56 ft) in position components prior to 320 sec.

3.1.6 Radar

The Patrick (0.18) radar was programmed to track the discarded S-I booster after separation. Reliable tracking data were received until 350 sec. Before separation, the 0.18 radar differed with the reference trajectory by less than 50 m (164 ft) in position data and less than 2 m/s (6.56 ft/s) in velocity data.

The Grand Bahama (3.16) radar reduced metric data were completely unusable. Figures 5 through 7 indicate the inconsistency of this data. Measured parameter comparisons indicate that the range measurement was valid but that the azimuth and elevation angles were in error by an average of 0.02 deg and 0.04 deg, respectively. The same errors were experienced on the SA-6 flight. An attempt is being made to identify the systematic errors causing this data inconsistency, but no results have been obtained at this time.

The Grand Turk (7.18) radar reduced metric data were considerably better than on SA-6. The 35 ms timing error was eliminated; however, measured parameter comparisons indicate that a bias of approximately 0.018 deg still remains in the elevation angle. The Grand Turk radar provided the best tracking coverage at S-IV stage cutoff since the Antigua (91.18) radar was inoperative for the SA-7 flight.

Uncorrected measured parameters from the Bermuda (BDA) radar were received from GSFC. A refraction correction was applied to this data. As a result of the long range and low elevation angle (3 deg) at S-IV stage cutoff, the reduced metric data contained a large amount of random error.

The Cape Kennedy (1.16) radar and San Salvador (5.16) radar provided good metric data during the intervals they tracked. An error in interrogating the onboard radar beacon caused both Grand Turk and Bermuda to lose track from approximately 400 to 475 sec.

3.2 Trajectory Composition

External tracking data, telemetered guidance data, radar altimeter data, and the insertion point coordinates were used to establish the postflight trajectory. This trajectory was constructed in the following manner:

- | | |
|----------------------|---|
| 0.0 - 19.0 sec: | Regular Fixed Camera and ODOP data were used in a least squares curve fit. The differences between the resulting curve fit and the actual data were negligible. (Reference 1 discusses in detail the least squares program used to establish this portion of the trajectory.) |
| 19.0 - 90.0 sec: | ODOP data processed by a smoothing and differentiation program (see the following paragraphs for more discussion on the smoothing and differentiation program). |
| 90.0 - 135.0 sec: | Azusa data processed by the smoothing and differentiation program. |
| 135.0 - 149.0 sec: | Azusa position data processed by the smoothing and differentiation program. Telemetered guidance data were used to determine the velocity and acceleration component profiles. |
| 149.0 - 631.375 sec: | A computed trajectory based on telemetered guidance velocity data, MISTRAM tracking data, the altimeter output, and the insertion point coordinates derived from orbital tracking (see the following paragraph for more discussion on the computed trajectory). |

Since the trajectory was constructed from several different data sources, it was necessary to provide for a merging or blending process to compensate for small biases that existed between data from the various sources. A merging program was used to connect the data from the different sources without creating a sharp transient. This was a least squares technique.

Telemetered guidance accelerometer data, in conjunction with MISTRAM tracking data, radar altimeter data, and the orbital insertion point coordinates, were used to construct the computed trajectory beginning at 149 sec. The guidance data were integrated, transformed, and adjusted to match the MISTRAM tracking data during the interval 149 to 500 sec, and the altimeter data, corrected for a 100 meter bias during the interval 500 to 631 sec. The portion of the trajectory between 500 and 631 sec was constructed to merge from the powered flight tracking data exactly into the insertion point determined from orbital tracking.

Since the downrange radars experience large random and cyclic errors, the conventional least square smoothing technique was revised. Desirable results were obtained when fourth degree coefficients were averaged with second degree coefficients covering a twenty sec interval (i.e., 101 points at a data rate of 0.2 sec or 201 points at a data rate of 0.1 sec, etc.). The amplitude of data oscillating at approximately 0.1 cps was reduced 90% with less than 0.1 m (0.3 ft) bias being induced. The frequency response of the coefficients is shown in Figure 8. These averaged coefficients were used to smooth the position data. However, fourth degree least square coefficients covering the same time interval were used to obtain velocity and acceleration data because the average coefficients would induce significant bias errors in the derivatives of position data during particular phases of the trajectory. A more detailed discussion of the smoothing technique can be found in Reference 2.

ODOP and Azusa data were smoothed using least square coefficients covering a 10 sec interval. It was determined that the 10 sec interval would be sufficient because ODOP and Azusa systems did not experience significant cyclic errors.

3.2.1 First Motion Time

Pad measurements 32-B01 and 32-B02 (Displacement at Stub Fins I and III) and vehicle displacement as measured from camera

data were available for the determination of first motion time. The first motion times indicated by these sources are given in the following table.

<u>Measurement</u>	<u>Range Time (sec)</u>
32-B01 and 32-B02	0.06
Camera Data	0.07

The decision was made by the Flight Evaluation Working Group to use the pad measurements for the determination of first motion time on SA-6 and all subsequent vehicles.

3.2.2 Powered Flight Trajectory

Table II presents a comparison of actual and nominal times of events in sequential order. The actual altitude and range are shown in Figures 9 and 10, respectively, for the entire powered flight. The actual total inertial acceleration profiles for the S-I stage and the S-IV stage are shown in Figure 11. The actual earth-fixed velocity along with the angle between the earth-fixed velocity vector and the local horizontal plane is shown in Figure 12. The actual space-fixed velocity along with the angle between the space-fixed velocity vector and the local horizontal plane is shown in Figure 13. Mach number and dynamic pressure are shown for the S-I stage powered flight in Figure 14. These parameters were calculated using measured meteorological data to an altitude of 27 km. (88582 ft). Above this altitude, the U. S. Standard reference atmosphere was used.

Various trajectory parameters are given at significant event times in Table III. Apex is given for both the S-IV stage and the discarded S-I stage. It should be noted that loss of telemetry signal and impact apply only to the discarded S-I stage. Several trajectory parameters are given for S-I stage inboard engine cutoff (IECO), S-I stage outboard engine cutoff (OECO) and S-IV stage guidance cutoff (S-IV CO) in Table IV. The velocity gain between OECO and separation due to thrust decay was 6.9 m/s (22.6 ft/s). The velocity gain from S-IV CO to end of thrust decay was 2.7 m/s (8.9 ft/s).

A comparison of the actual and nominal trajectory can be found in Reference 3. The nominal SA-7 trajectory can be found in Reference 4.

The actual trajectory is presented in the metric system of units in Table X through XIV and in the English system of units in Tables XVI through XX.

3.3 Error Analysis of Reference Trajectory

During the S-I powered portion of flight, good coverage was provided by the 1.16 radar, ODOP, Azusa, and MISTRAM tracking systems. The ODOP and Azusa data were used to establish the majority of the reference trajectory over this time. The available tracking data covering the later portion of S-IV powered flight were not completely satisfactory; therefore, telemetered guidance velocity data in conjunction with tracking data and the orbital insertion point were used to compute the trajectory during the interval 149 to 631.375 sec. Data from the various tracking sources are compared with the reference trajectory in Figures 5 through 7. All data were smoothed and transferred from the point of track (antenna locations) to a common point, the vehicle's center of gravity. These curves show only the trend of the data relative to the reference trajectory.

The dispersion of the various data gives an indication of the validity of the reference trajectory. The maximum difference in vehicle position as indicated by the 1.16 radar, ODOP, Azusa, and MISTRAM tracking systems from 50 to 150 sec was less than 20 m (66 ft) in the X-component, 20 m (66 ft) in the Y-component, and 10 m (33 ft) in the Z-component. The majority of this deviation is attributed to the radar data. Fairly large deviations are present for the time after 150 sec.

An estimate of the probable total uncertainty in the powered flight reference trajectory is shown in Figure 15. At OECO the position components are probably accurate to 20 m (66 ft) and the velocity components to 0.2 m/s (0.7 ft/s). By S-IV CO the maximum uncertainties increase to about 0.7 m/s (2.3 ft/s) in Y and 0.4 m/s (1.3 ft/s) in X and Z velocity components. The uncertainties in position components are 115 m (377 ft) in Z and 200 m (656 ft) in X and Y.

4.0 S-I STAGE FREEFLIGHT TRAJECTORY

A theoretical freeflight trajectory was computed for the discarded S-I stage using initial conditions from the Patrick (0.18) radar at 180 sec. The 0.18 radar data were numerically smoothed using least

squares coefficients (see Figure 8 for frequency response of coefficients). The smoothed velocities were then manually plotted so that low-frequency oscillations could be removed. The radar tracking became invalid after 350 sec. At this time, the computed trajectory deviated from tracking by less than 20 m (66 ft) in position components.

Since the attitude of the booster during re-entry is unknown, a nominal tumbling drag coefficient was assumed. Nominal coefficients of drag were also used assuming the booster (1) stabilized at an angle-of-attack of 90° and (2) stabilized at an angle of attack of 0°. These provide the following extreme cases:

<u>Drag Condition</u>	<u>Impact Range</u>	<u>Impact Time</u>
0° Angle of Attack	885.5 km (478.1 nm)	518.84 sec
Tumbling	883.7 km (477.2 nm)	536.80 sec
90° Angle of Attack	882.4 km (476.5 nm)	555.52 sec

The theoretical freeflight trajectory utilizing the tumbling drag coefficient data will be considered as the actual freeflight trajectory of the booster. The impact location relative to the launch site is shown in Figure 16, and the trajectory is presented in tabular form in Tables IX and XV.

Impact information was also obtained from RCA, Air Force Eastern Test Range. This information indicated a surface range of 864 km (466.5 nm), a geodetic latitude of 26.156 deg, a longitude of 72.241 deg, and an impact time of 613.8 sec. No attempt was made to recover the camera capsules because of poor weather conditions in the impact area.

5.0 ORBITAL FLIGHT

5.1 Orbital Trajectory

The S-IV-7 stage with Instrument Unit and an Apollo boilerplate payload was inserted into orbit on September 18, 1964, at 16:33:14.375 U.T. (631.375 sec range time). Figure 17 is a ground projection plot showing the locus of the first three orbital revolutions. The orbital insertion conditions for SA-7 were determined by a differential correction procedure using radar beacon track data and minitrack direction cosine data.

The classical osculating two-body orbital elements and the corresponding position and space-fixed velocity vectors at orbital insertion are shown in Table V. The orbital elements are referenced to the mean equinox and equator at 0 hr U. T. the day of launch.

A comparison between some of the actual and nominal (preflight trajectory) orbital insertion parameters is shown in Table VI.

The slightly higher than nominal velocity (2.8 m/s or 9.1 ft/s) and lower altitude (1 km or 0.53 nm) at insertion explain the deviations between the actual and nominal orbital elements. The insertion into orbit at a slightly lower altitude than the nominal with the increase in velocity at insertion, increased the apogee altitude by 6 km (3.2 nm). The change in orbital elements from the nominal increased the nominal lifetime by approximately 0.2 days. The remaining lifetime increase of 0.4 days over the nominal is mainly attributable to the variation in the apparent drag force from the nominal.

The RMS error of the data residuals and the number of data observations utilized are listed in the following table.

INSERTION TRACKING

Station	Time of Track (Universal Time)	Data Types	No. of Valid Observations	RMS Error of Residuals
Grand Turk Island (FPQ-6)	16:33:14-16:33:49 (631-666 sec R. T.)	AZ EL RA	32 27 29	0.005° 0.016° 2 m (7 ft)
Bermuda (FPS-16)	16:33:14-16:33:29 (631-646 sec R. T.)	AZ RA	23 29	0.011° 9 m (30 ft)
Onboard Radar Altimeter	16:33:14-16:35:55 (631-792 sec R. T.)	AE**	114	41 m (135 ft)
Pretoria, South Africa (FPS-16)(Pass 1)	16:55:44-17:01:44	AZ EL RA	42 37 61	0.011° 0.009° 12 m (39 ft)
Johannesburg, South Africa (Minitrack) (Pass 1)	16:58:09-16:58:41	CA* CB*	7 7	0.00063 0.00041

INSERTION TRACKING (CONTD)

Station	Time of Track (Universal Time)	Data Types	No. of Valid Observations	RMS Error of Residuals
Carnarvon, Australia (FPQ-6)	17:19:54-17:21:36	AZ EL RA	15 12 14	0.002° 0.017° 3 m (10 ft)
Goldstone Lake, Calif. (Minitrack)	17:53:28-17:53:36	CA* CB*	2 3	0.00047 0.00035
Patrick AFB, Fla. (FPQ-6)	17:59:44-18:03:32	AZ EL	31 26	0.006° 0.007°
Pretoria, South Africa (FPS-16) (Pass 2)	18:29:31-18:35:07	AZ EL RA	48 45 40	0.006° 0.035° 6 m (20 ft)
Johannesburg, South Africa (Minitrack) (Pass 2)	20:05:42-20:05:50	CA*	3	0.00039

* CA and CB are Minitrack direction cosines measured from North-South and East-West station baselines, respectively.

** AE is the altitude above the Earth's surface.

The RMS residual tracking errors which represent the difference between the actual radar observation values and the orbit defined by the insertion conditions quoted in the tabulation, were from 1-4 times higher than the expected high frequency errors of the measuring systems employed. Included in the RMS residual errors are high frequency errors (assumed gaussian) and systematic errors due to possible instrumentation bias, mathematical model errors and atmospheric refraction errors. The maximum RMS error of the radar residuals was 12 m (40 ft) in range, 0.04 deg in elevation, and 0.01 deg in azimuth. The maximum RMS error of the Minitrack direction cosine residuals was 630 parts per million. The onboard radar altimeter RMS residual error was approximately 40 m (130 ft).

Expected high-frequency errors of the measuring systems are 3 m (10 ft) in range, and 0.003 deg in angles for the FPQ-6 radars (design specifications), 6 m (20 ft) in range and .01 deg in angles for the FPS-16 radars (from prior experience), 250 parts per million for the Minitrack direction cosines (from prior experience) and 30 m (100 ft) in the altimeter data (estimated). The Patrick range data were deleted from the final solution because of their incompatibility with all other data used. The reason for this incompatibility may be in the correction of the data for refraction and other errors. Further efforts are being made to determine why the data were incompatible.

5.1.1 Orbital Insertion Analysis

The orbital insertion parameters quoted in Table V were obtained by solving for the position and velocity vector at insertion in addition to the effective drag and error in the geodetic location of Carnarvon, Australia. The following table shows the deviations at insertion of selected parameters from the independent powered flight tracking and guidance data trajectory, and solutions obtained from orbital tracking considering (1) possible Carnarvon Station location error source and (2) not considering this possible error source. The independent powered flight trajectory considered in the comparisons has not been adjusted to orbital tracking solution at insertion.

Parameter	Deviation (Orbit Determination minus Powered Flight)	
	Solution (1)	Solution (2)
Altitude	7 m (23 ft)	-28 m (-92 ft)
Vector Distance from Launch Site	47 m (154 ft)	45 m (148 ft)
Space-Fixed Velocity	-0.1 m/s (-0.3 ft/s)	0.0 m/s (0.0 ft/s)
XE } Earth-Fixed Plumbline	44 m (144 ft)	40 m (131 ft)
YE } Position Components	-9 m (-30 ft)	-45 m (-148 ft)
ZE }	69 m (226 ft)	61 m (200 ft)
DXE } Earth-Fixed Plumbline	0.0 m/s (0.0 ft/s)	0.1 m/s (0.3 ft/s)
DYE } Velocity Components	0.4 m/s (1.3 ft/s)	0.4 m/s (1.3 ft/s)
DZE }	0.0 m/s (0.0 ft/s)	0.0 m/s (0.0 ft/s)

It was impossible to constrain the powered flight trajectory to the Y plumbline position and velocity of orbital solution (2). The Y position and velocity deviations were in opposite directions and integration of the adjusted velocities would not yield consistent positions, unless unrealistic velocity adjustments

were made. Solution (1) reduced the Y position deviation considerably and allowed a more realistic velocity adjustment. The final powered flight trajectory was constrained to solution (1).

The solution for Carnarvon station coordinates reduced the range data residual errors for Carnarvon by approximately an order of magnitude and reduced all other data residual errors by 50 percent. Some apparent systematic errors that were evident in the data residuals were either eliminated or reduced. The results of the solution for Carnarvon station coordinates were 0.0022 ± 0.0001 deg in latitude and 0.0005 ± 0.0003 deg in longitude (approximately 200 m or 650 ft). The Carnarvon station coordinates (referenced to the Fischer Ellipsoid) derived from the solution are 24.8951 deg S latitude and 113.7166 deg E longitude. This deviation in station coordinates appears roughly compatible with the quoted accuracy for the Carnarvon radar survey (± 150 m or 500 ft per telephone conversation with GSFC), but it will be necessary to evaluate more tracking data from Carnarvon on other orbital passes and on future flights to draw any positive conclusions.

Insertion condition solutions were made using various combinations of the data quoted, solving for and not solving for effective drag and suspected station geodetic location error. All solutions are within 400 m (1300 ft) in any position component and 0.4 m/s (1.3 ft/s) in any velocity component. These maximum deviations are believed to represent a valid estimate of the maximum error in the position and velocity at orbital insertion. However, the deviations between the powered flight trajectory and the orbital tracking solutions illustrated in the previous table indicate a more realistic position component error (70 m or 230 ft).

5.1.2 Orbital Decay and Re-Entry

The SA-7 apogee and perigee altitudes from insertion to re-entry are shown in Figure 18. The orbital decay history was established by GSFC on a real time basis for the entire lifetime of the vehicle and upon postflight analysis performed by MSFC. The initial apogee and perigee decay rates were 6 km/day (3.2 nm/day) and 3 km/day (1.6 nm/day), respectively.

The orbital tracking data available for the determination of the terminal decay and re-entry (uncontrolled) of SA-7 are given in the following table.

Terminal Tracking

<u>Station</u>	<u>Acquisition Time</u> (Universal Time)	<u>Type of Data</u>
Patrick AFB, Fla.	11:12:36 Sept 22	Radar Skin Track
Eglin AFB, Fla.	11:12:42 Sept 22	Radar Skin Track
Wallops Island, Va.	11:14:30 Sept 22	Radar Skin Track
Kano, Nigeria	11:33:39 Sept 22 (last signal received from vehicle)	136 MC Telemetry Signal

An orbit determination was made for the position and velocity vectors at an epoch of 10:57 U.T. Sept 22 using the Patrick and Eglin radar data (the Wallops data were not utilized due to their extreme range). The terminal epoch conditions are presented below:

Terminal Epoch Conditions

Universal Time (Sept 22, 1964)	10:56:21
Semi-Major Axis	6508.56 km (3514.34 nm)
Eccentricity	0.00122315
Inclination	31.7612 deg
Right Ascension of Ascending Node	15.9337 deg
Argument of Perigee	21.0631 deg
True Anomaly	-20.0947 deg
Mean Sidereal Time (0 hr Sept 22, 1964)	0.88698 deg
Altitude from Center of Earth	6501.09 km (3510.31 nm)
Space-Fixed Velocity	7834.78 m/s (25704.61 ft/s)

The orbital parameters determined were then used as initial conditions for an integration of the orbit to impact. This extrapolated orbit yields a Kano acquisition time of 11:32:58 U. T. (0° elevation), which is in reasonable agreement with the Kano observation. The orbit would reach the estimated break-up altitude of 86 km (46.5 nm) at approximately 11:50 U. T. Sept 22, at coordinates of 21.7 deg S latitude and 56.4 deg E longitude (see Figure 19). The theoretical ballistic impact time is approximately 12:00 U. T. at coordinates 26.4 deg S latitude and 69 deg E longitude (Southeast of Madagascar in the Indian Ocean). This re-entry location is consistent with the fact that no signal was received from the Minitrack beacon after the Kano observation. Monitoring for the 136 MC beacon at Carnarvon and Woomera, Australia and South Point, Hawaii confirmed that the vehicle was no longer in orbit.

An analysis of the error limits associated with the re-entry point shows the 2σ error limits to be approximately ± 30 m (± 100 ft) in altitude and ± 0.4 m/s (± 1.3 ft/s) in velocity, indicated by the consistency of fit of the tracking data used in the 10:57 U. T. orbit determination. These errors are highly correlated. Propagating these errors through the terminal orbit leads to extrapolated 2σ error limits for the time of 86 km (46.5 nm) break-up altitude of about ± 30 sec or approximately ± 200 km (± 110 nm) ground range. These limits are indicated in Figure 19. However, the true error limits are larger due to systematic orbit determination error not included and due to possible variation in the assumed drag and vehicle attitude (assumed tumbling) over the last half hour of flight.

A theoretical ballistic impact time of 11:59 U. T. Sept 22 has been reported by GSFC, based on the same terminal tracking data. The reason for the difference in solutions is not known, but may be due to slightly different assumptions made or refinement of data. The coordinates of the theoretical ballistic impact reported by GSFC are 25.3 deg S latitude and 65.5 deg E longitude. This impact location differs by approximately 400 km (220 nm) from that mentioned with the 10:57 U. T. solution approximately twice the uncertainty mentioned above.

5.2 Orbital Tracking Summary

Orbital tracking of the SA-7 vehicle was conducted by the NASA Space Tracking and Data Acquisition Network (STADAN), which is composed of the global network of Minitrack stations and Minitrack optical tracking stations (MOTS), and the Manned Space Flight

Network (MSFN), supported by elements of DOD, which is a global network of radar tracking stations. Additional tracking support was provided by the Smithsonian Astrophysical Observatory (SAO), and the North American Air Defense (NORAD).

Table VII shows a summary of the STADAN, NORAD, and SAO observations made on SA-7 for the vehicle lifetime. The first day of orbital flight there were six Minitrack passes. After the first day there were an average of 9 Minitrack passes per day for the remaining lifetime of the vehicle. The last vehicle contact was a 136 MC telemetry signal received by Kano, Nigeria on the 59th revolution at 11:33:39 U.T. Sept 22, 1964.

Table VIII shows the number of valid radar tracking passes per day for the lifetime of the vehicle. The last beacon track of the orbiting vehicle was $4\frac{1}{2}$ hours after liftoff by Hawaii. All subsequent radar tracking was skin track. It can be seen that the skin track observations made on SA-7 were as successful as they were on SA-6. The last skin track of the vehicle was at 11:18:53 U.T. Sept 22, 1964, by Wallops Island, Virginia.

There were four optical observations (Baker Nunn Camera) reported by SAO and two optical observations (MOTS) reported by STADAN. No comments were received concerning the stellar magnitude of the orbiting vehicle. Thirteen NORAD observations were also reported.

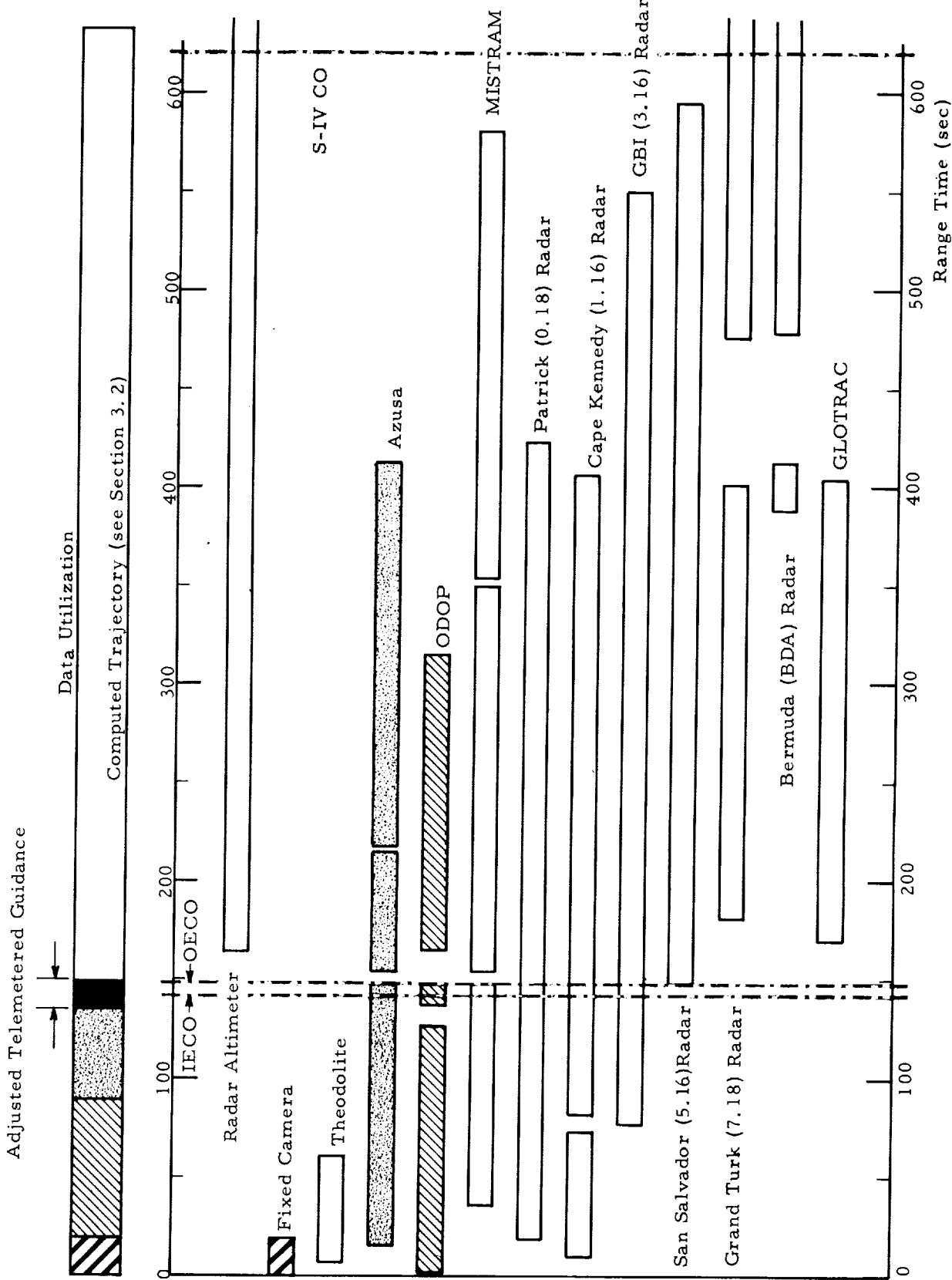


FIGURE 1 AVAILABLE FINAL TRACKING DATA (POWERED FLIGHT)

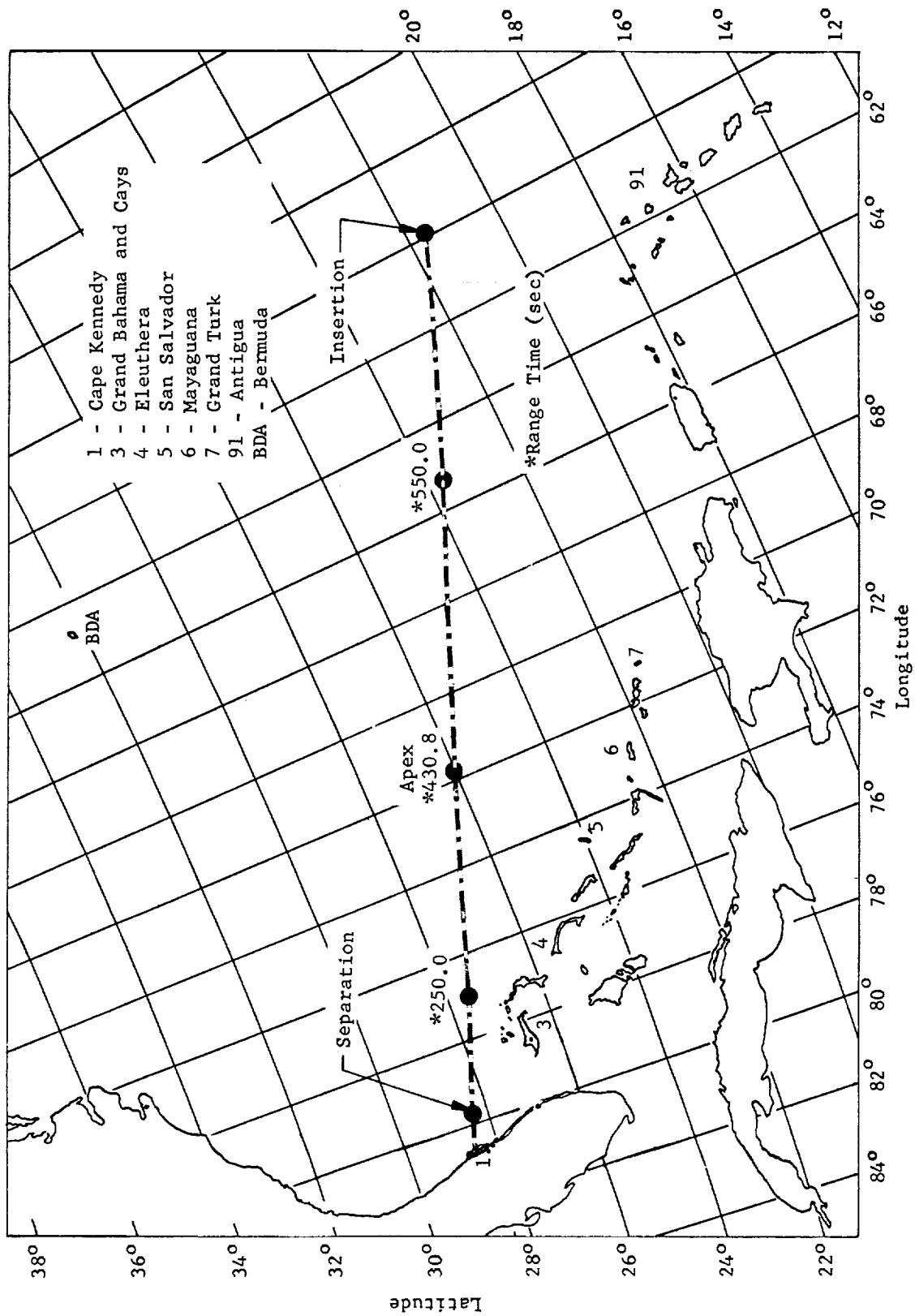


FIGURE 2 TRACKING STATIONS

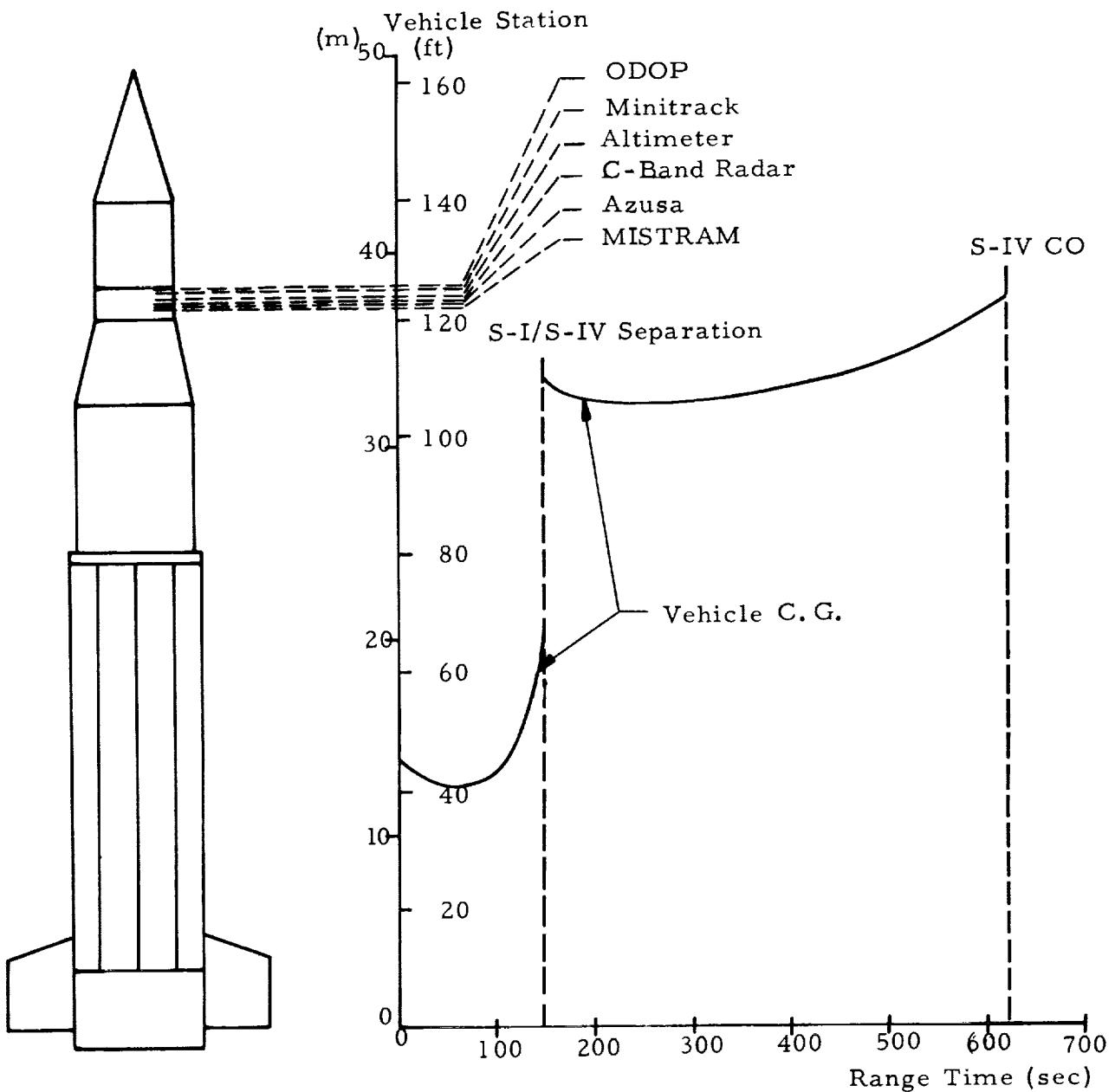


FIGURE 3 ANTENNA LOCATIONS AND
VEHICLE CENTER OF GRAVITY
VERSUS RANGE TIME

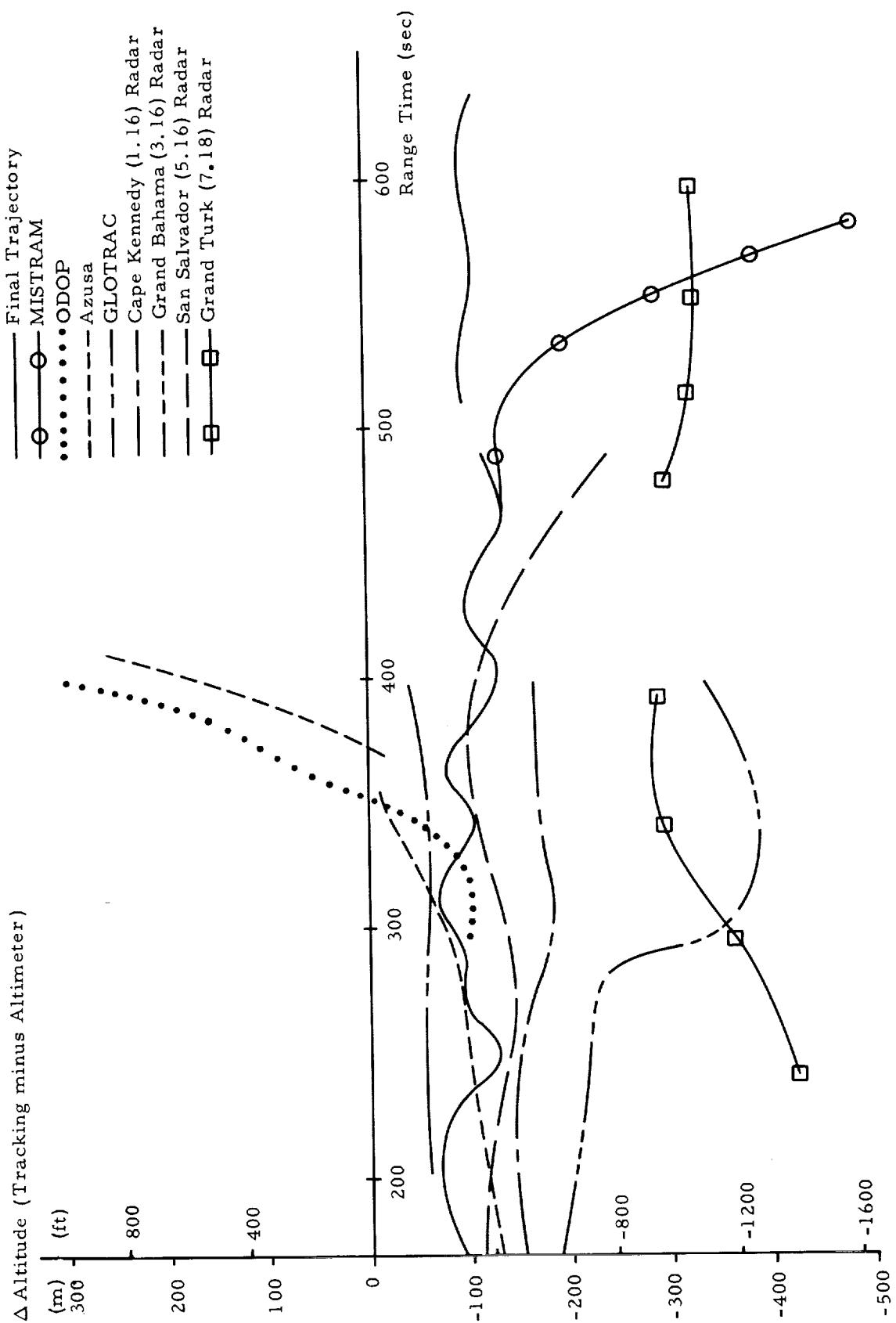


FIGURE 4 ALTITUDE COMPARISONS

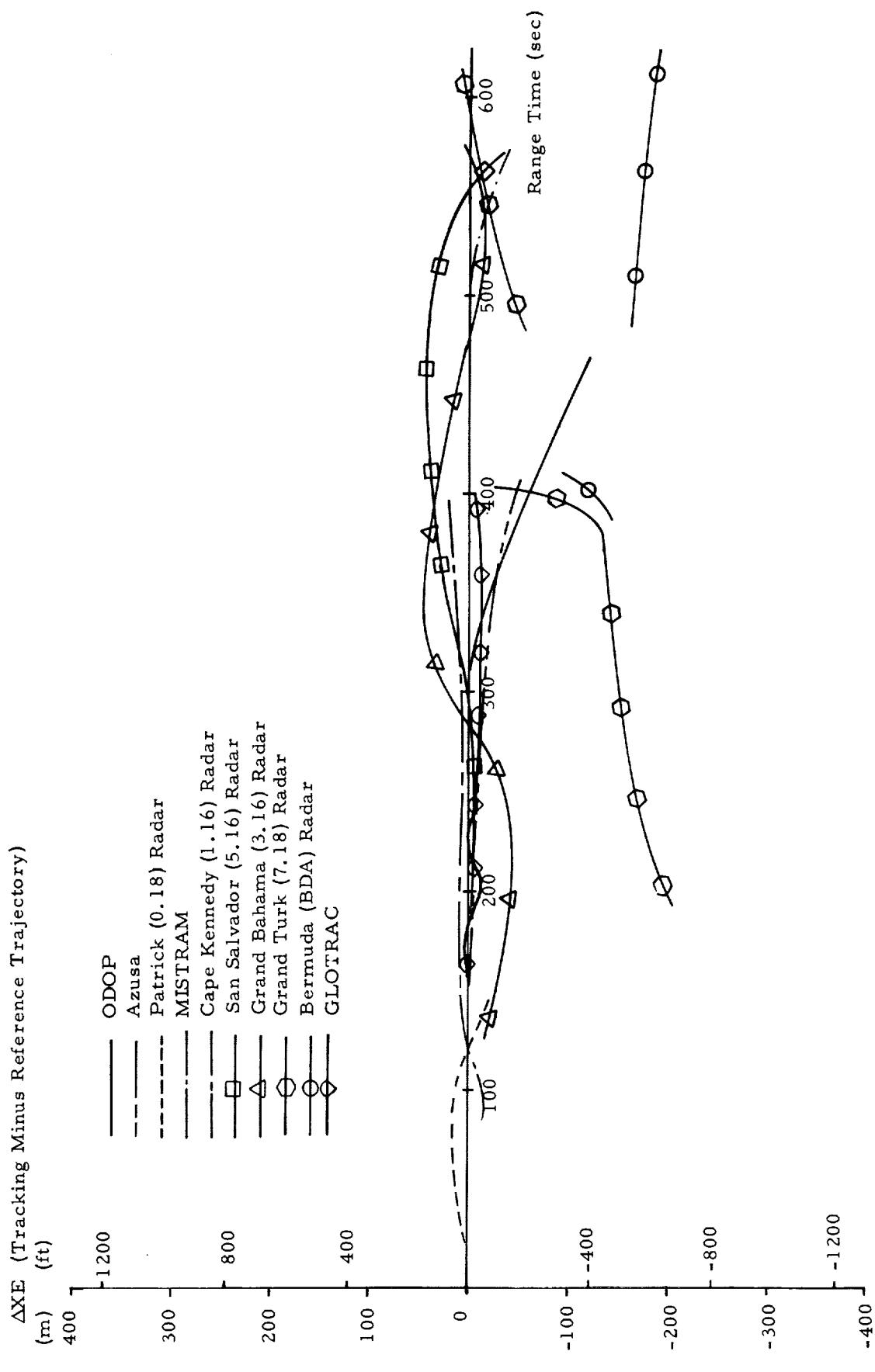


FIGURE 5 TRACKING COMPARISONS (POWERED FLIGHT)

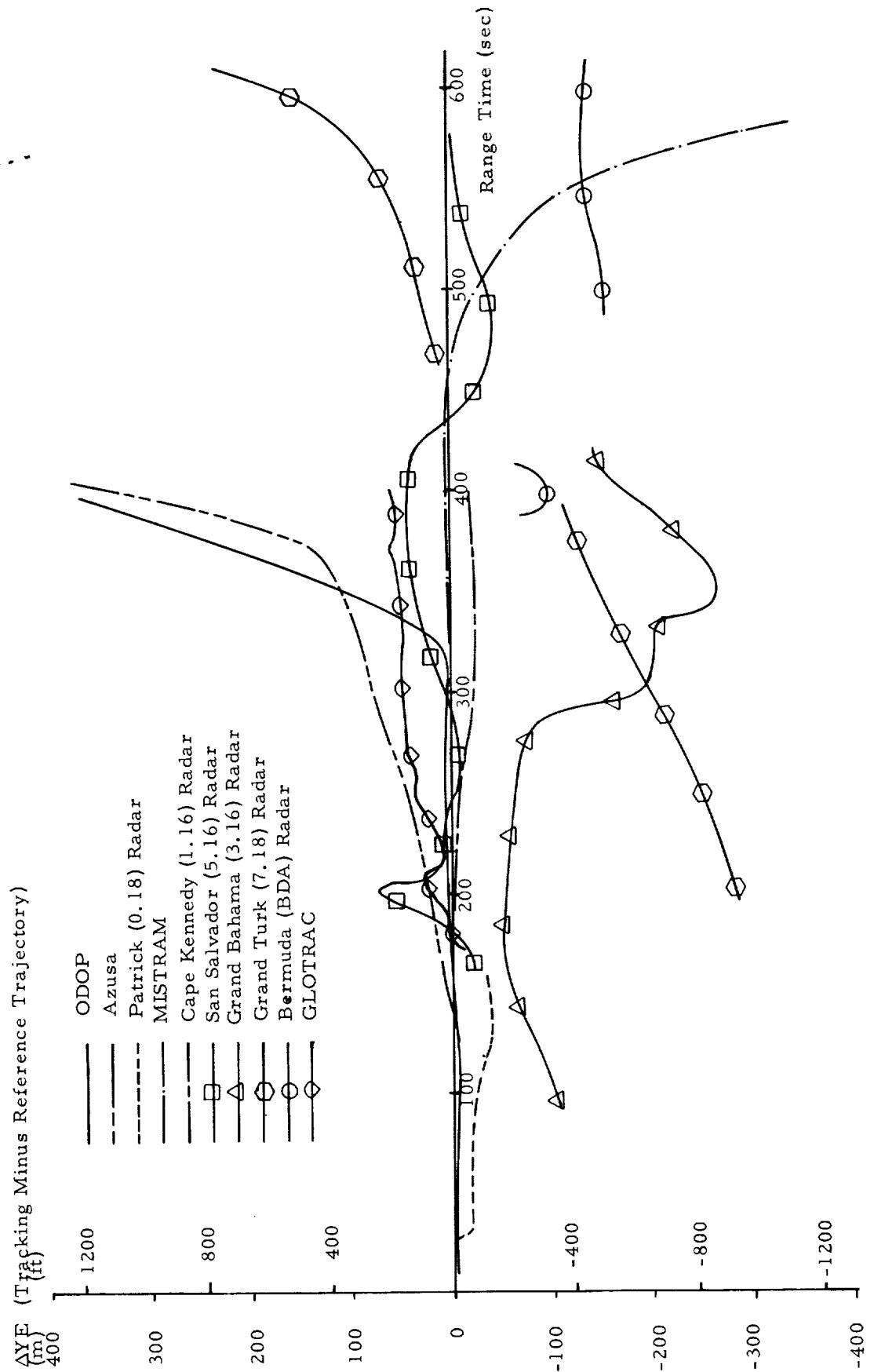


FIGURE 6 TRACKING COMPARISONS (POWERED FLIGHT)

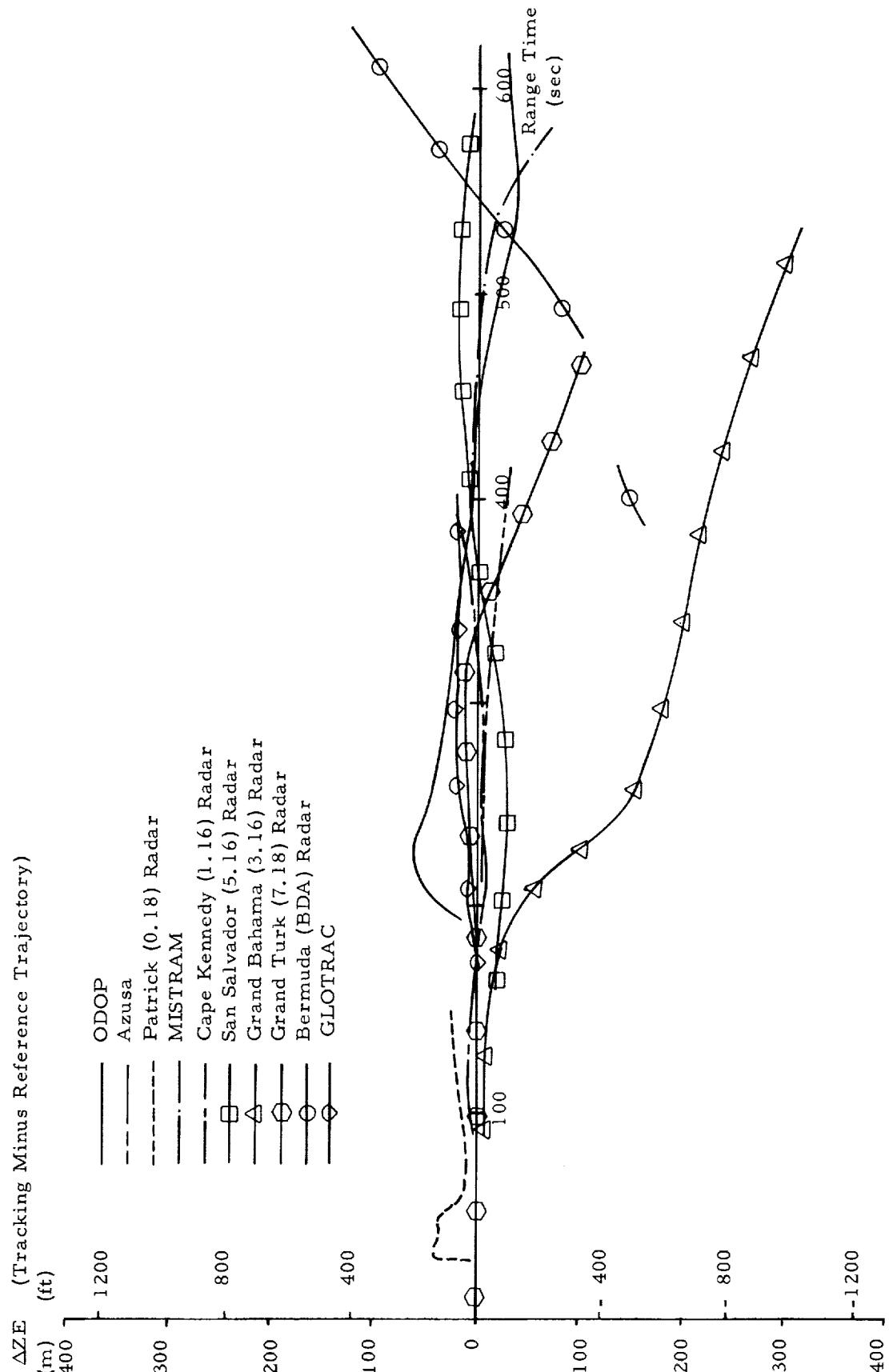


FIGURE 7 TRACKING COMPARISONS (POWERED FLIGHT)

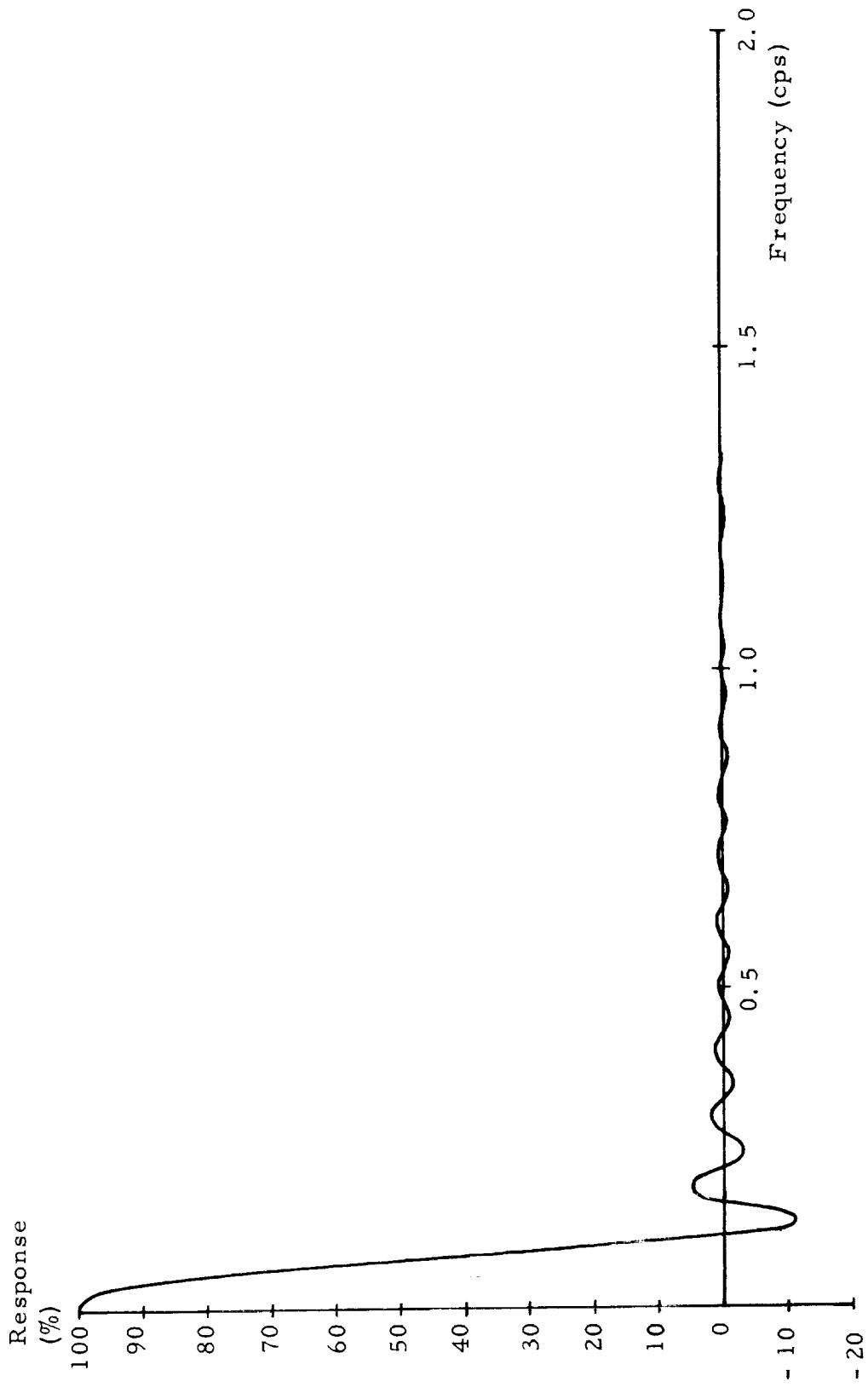


FIGURE 8 FREQUENCY RESPONSE OF SMOOTHING COEFFICIENTS

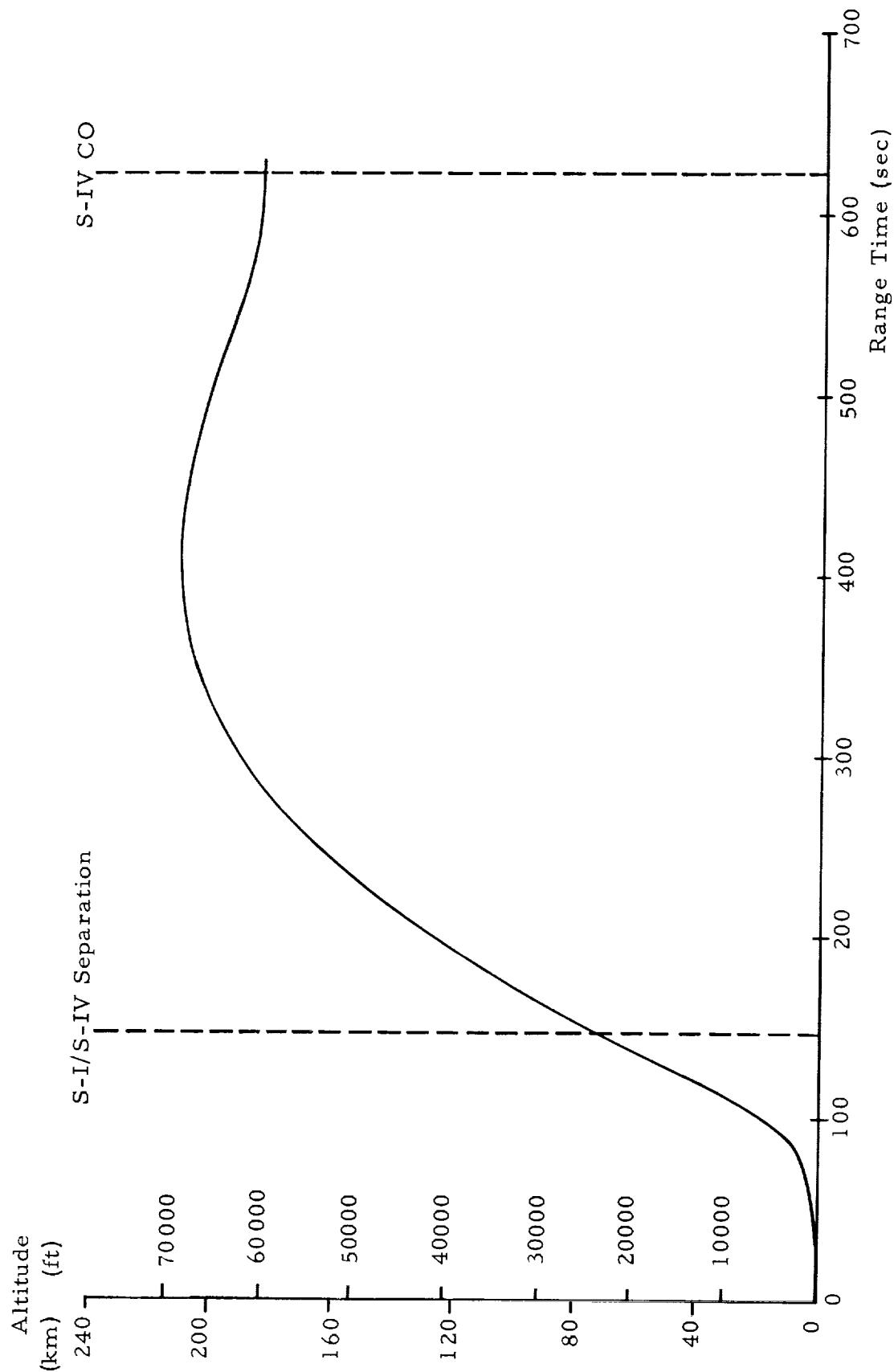


FIGURE 9 ALTITUDE

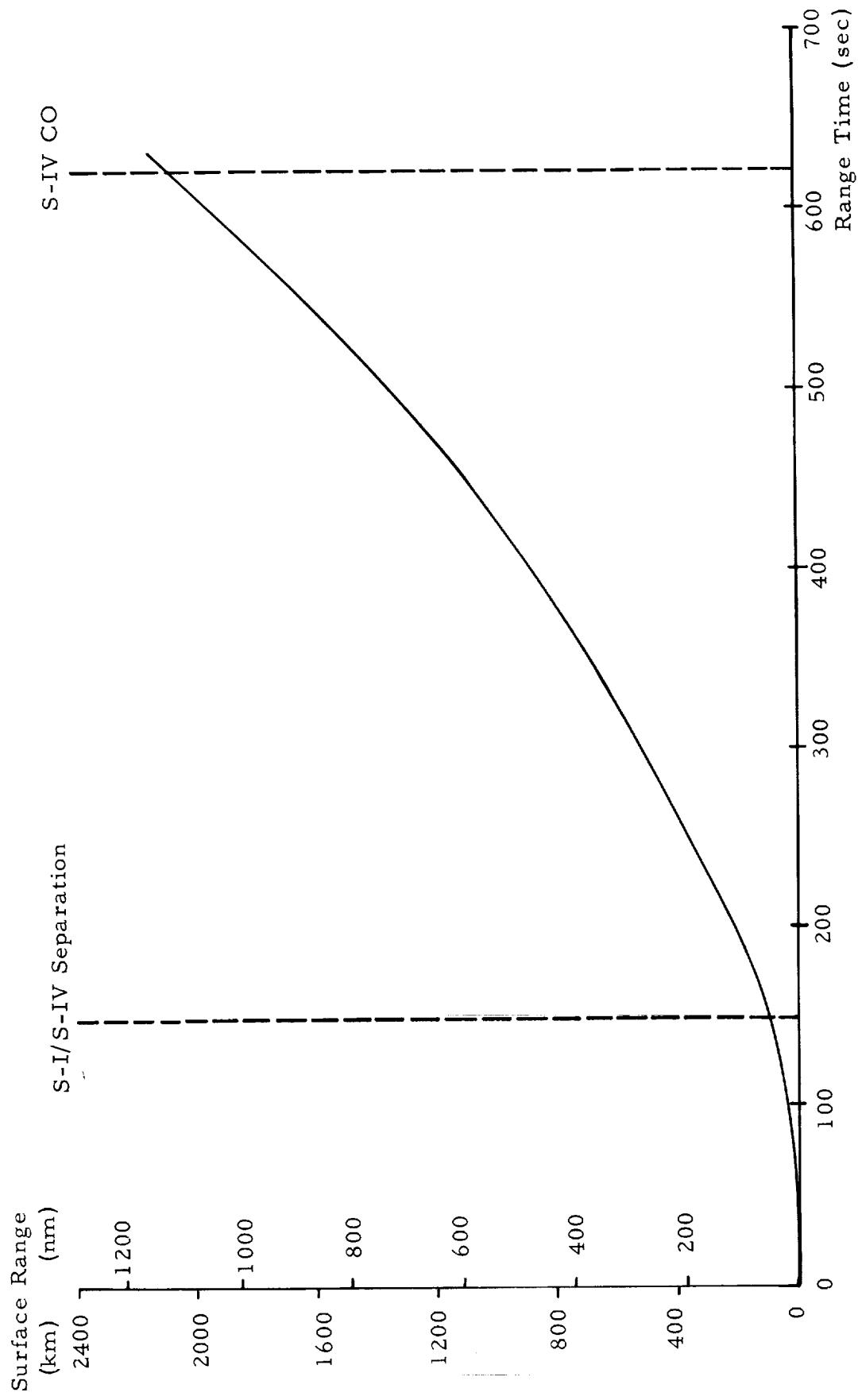


FIGURE 10 SURFACE RANGE

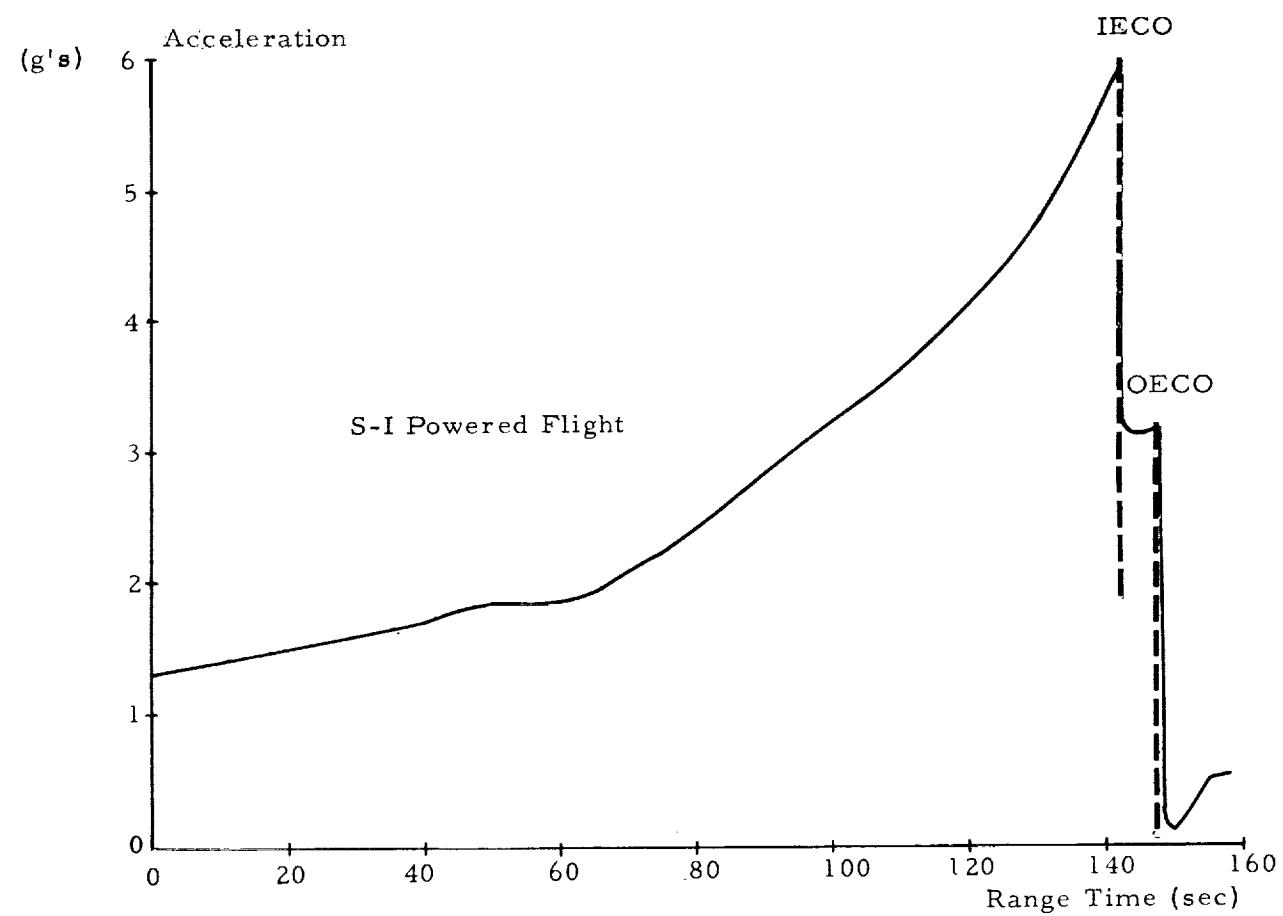
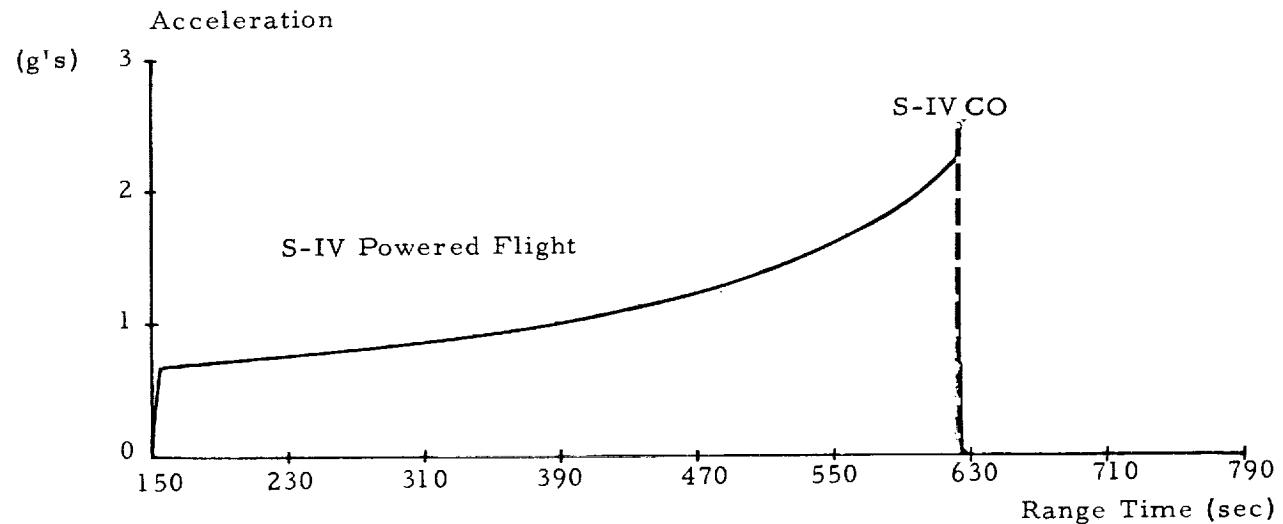


FIGURE 11 TOTAL INERTIAL ACCELERATION

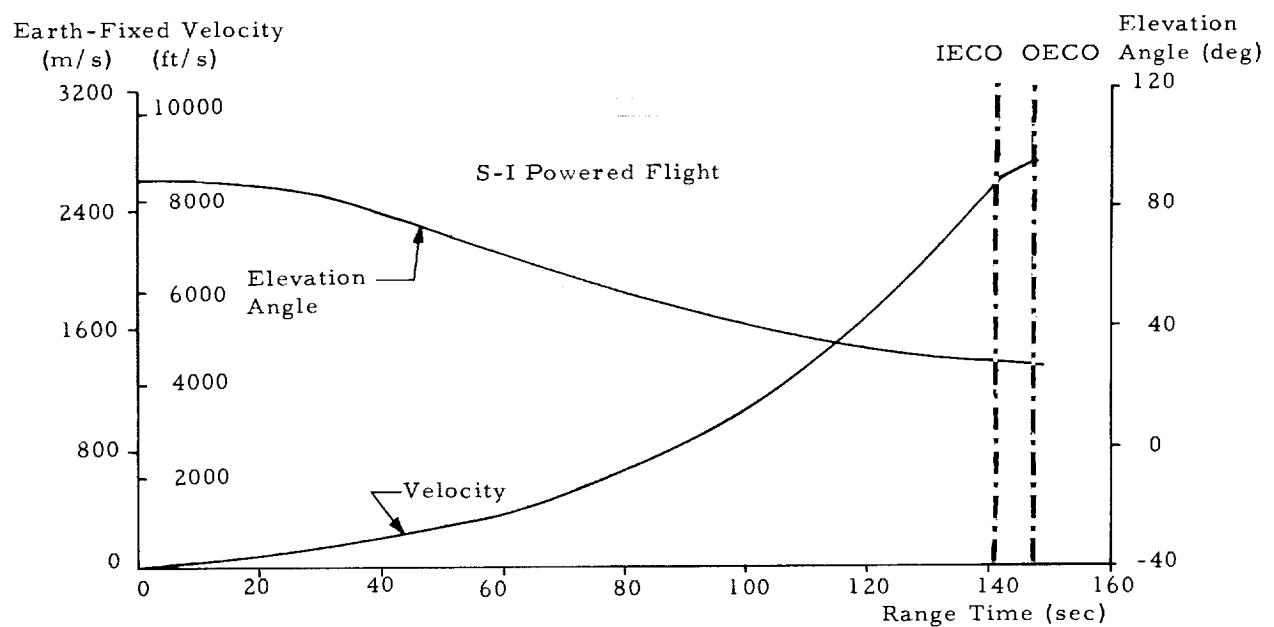
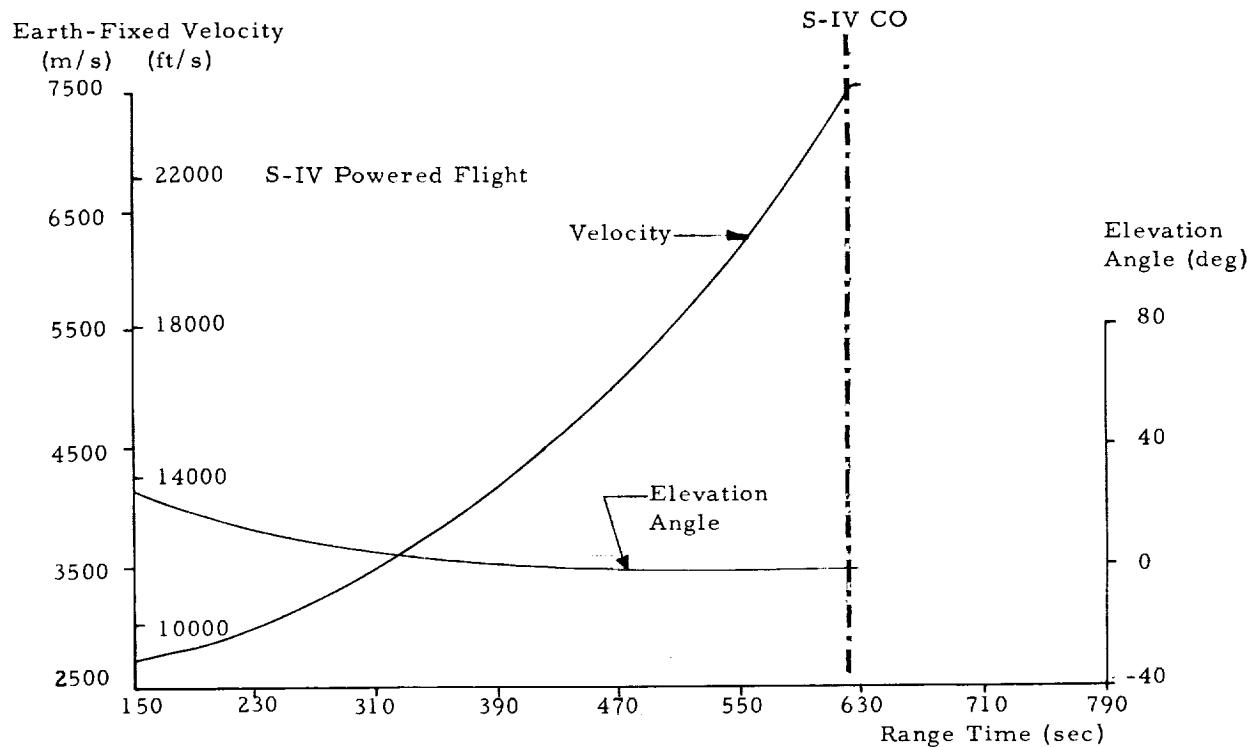


FIGURE 12 EARTH-FIXED VELOCITY AND ELEVATION ANGLE

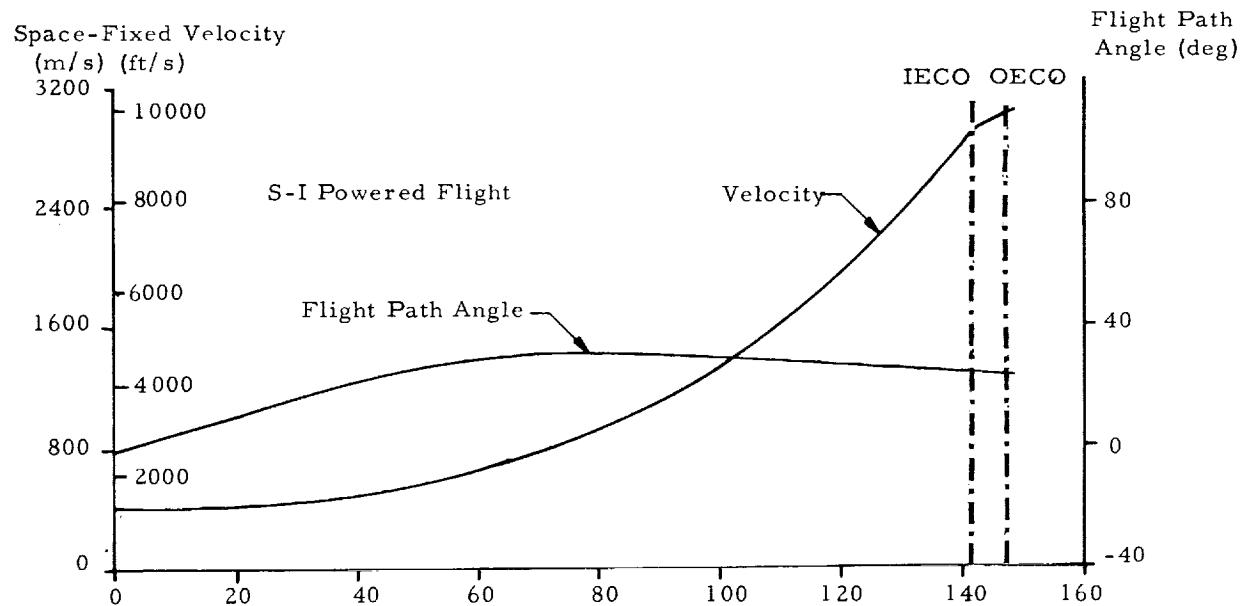
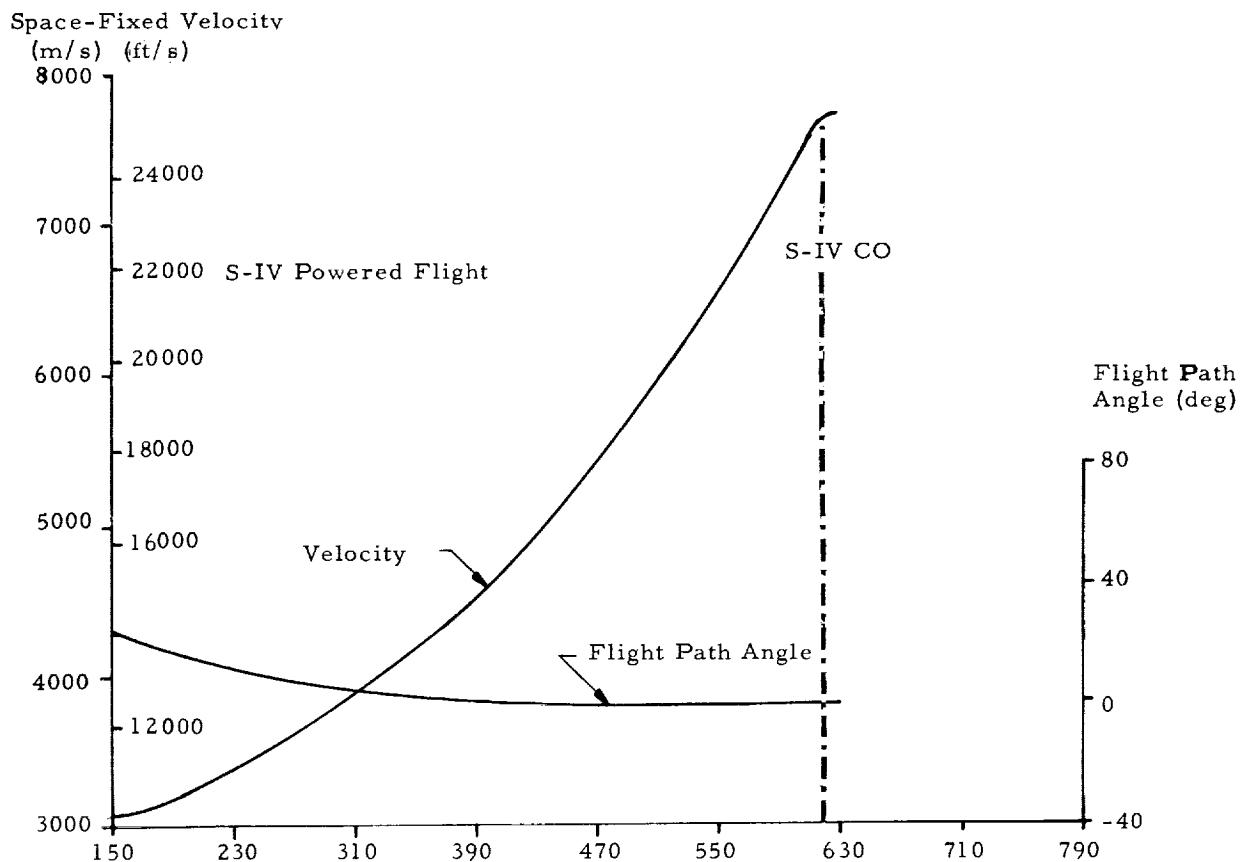


FIGURE 13 SPACE-FIXED VELOCITY AND FLIGHT PATH ANGLE

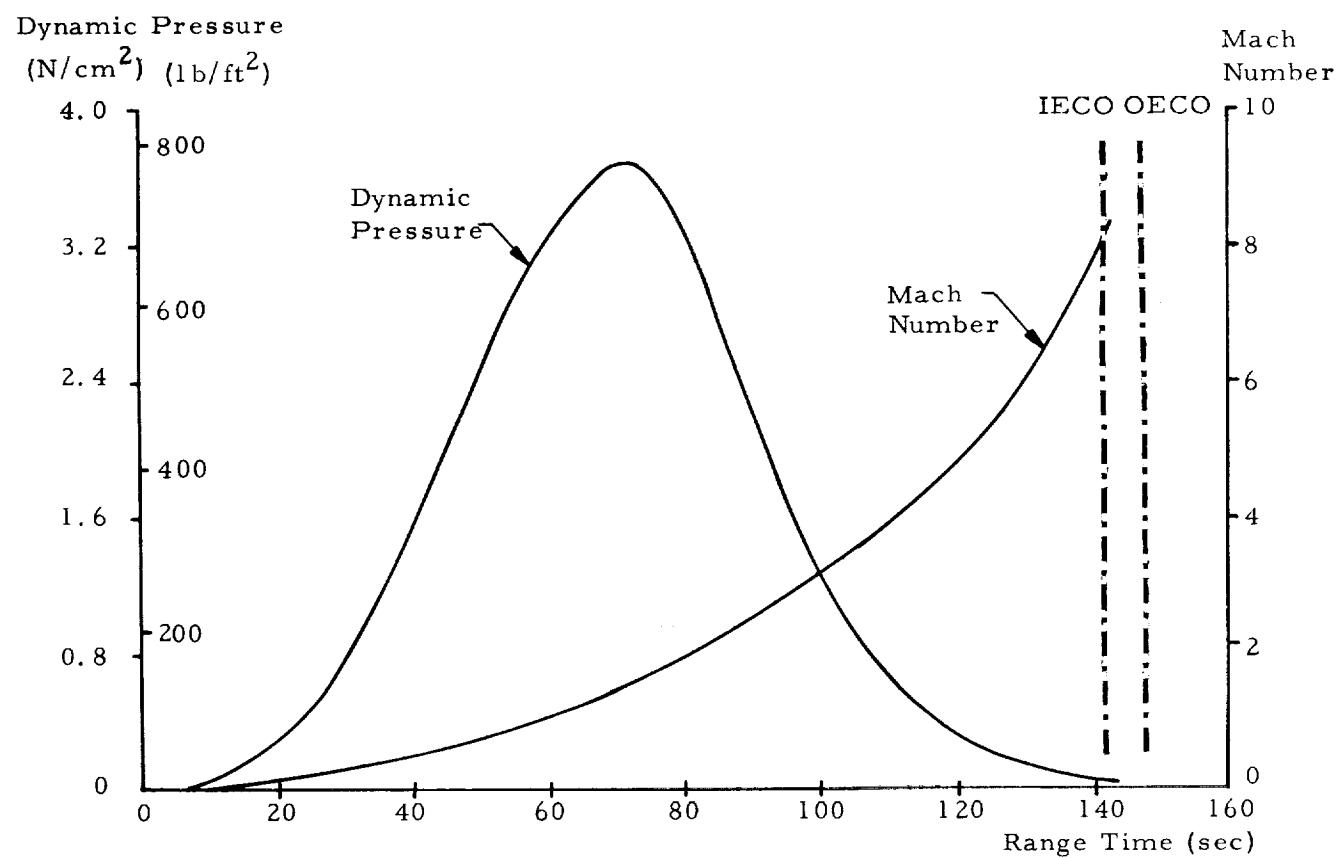


FIGURE 14 MACH NUMBER AND DYNAMIC PRESSURE

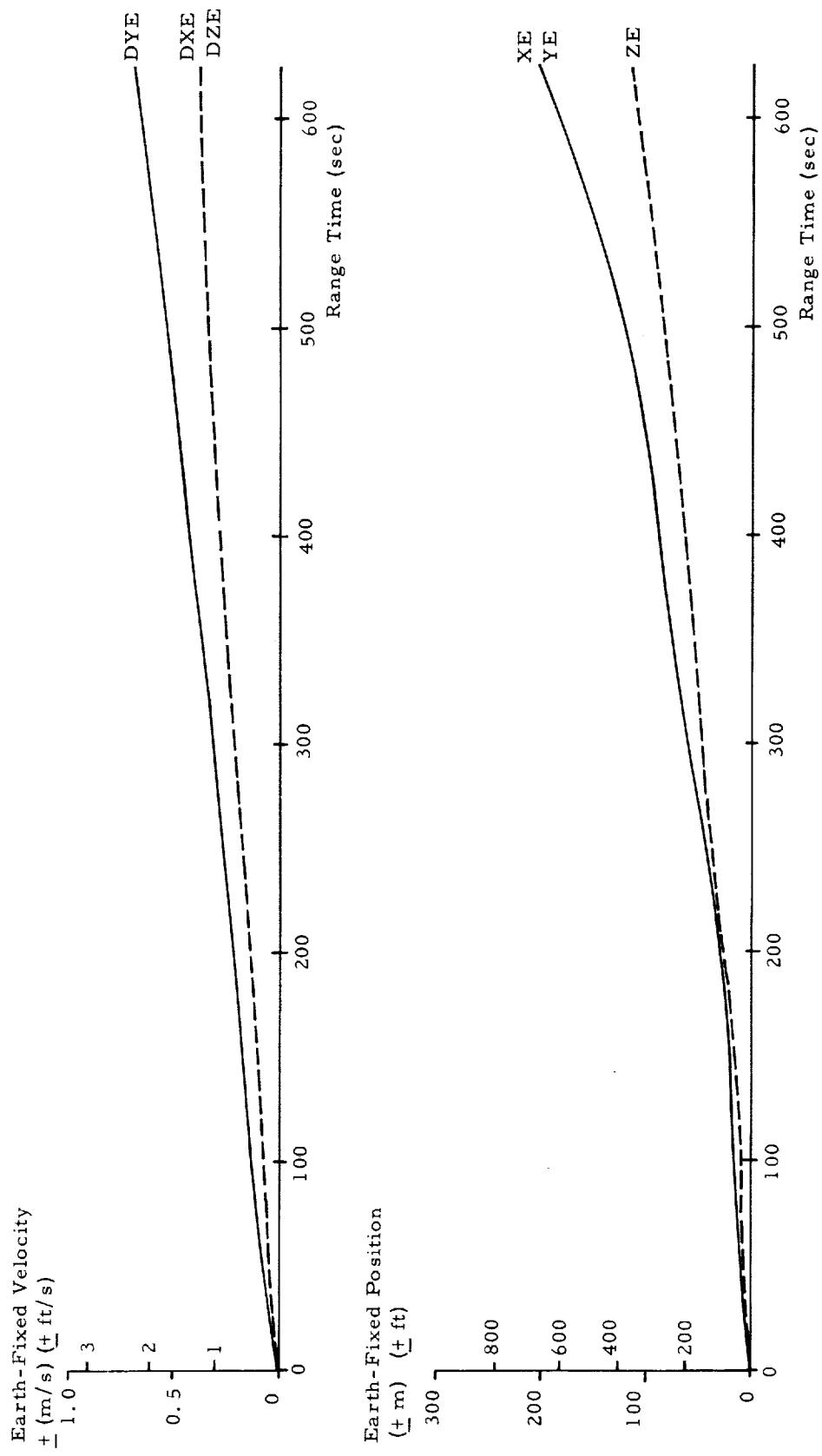


FIGURE 15 ESTIMATED UNCERTAINTY OF REFERENCE TRAJECTORY

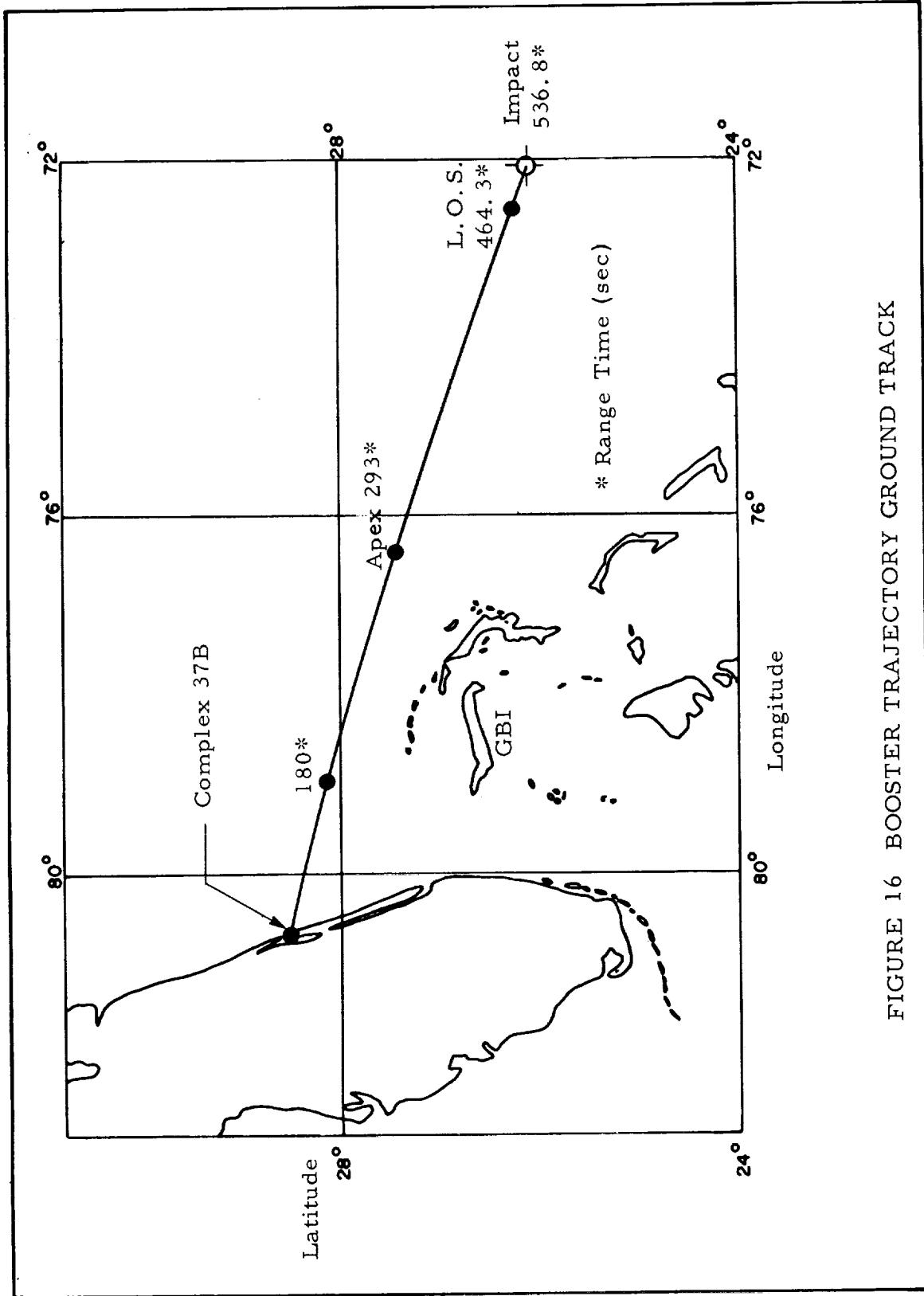


FIGURE 16 BOOSTER TRAJECTORY GROUND TRACK

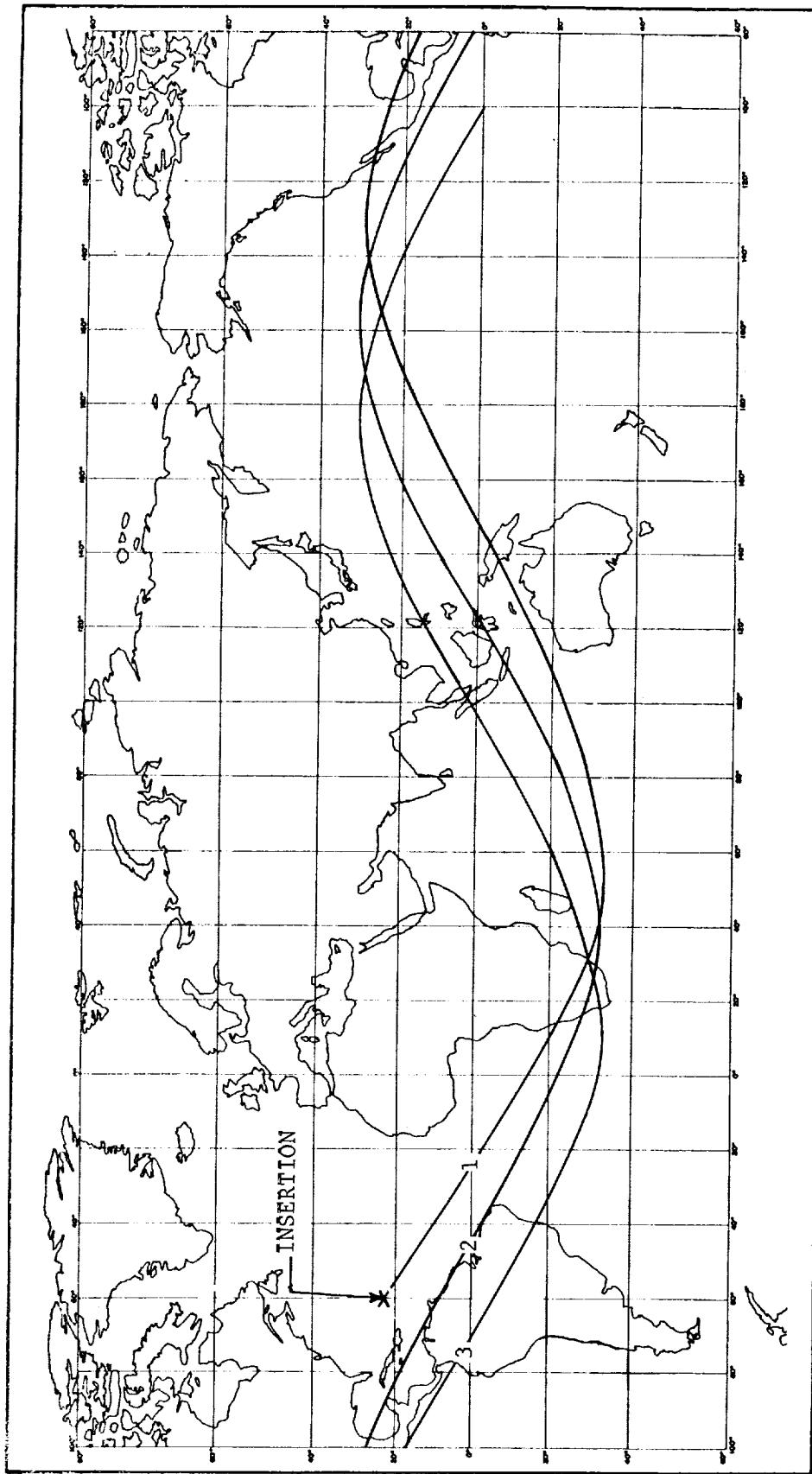


FIGURE 17 GROUND PROJECTION OF FIRST THREE EARTH REVOLUTIONS

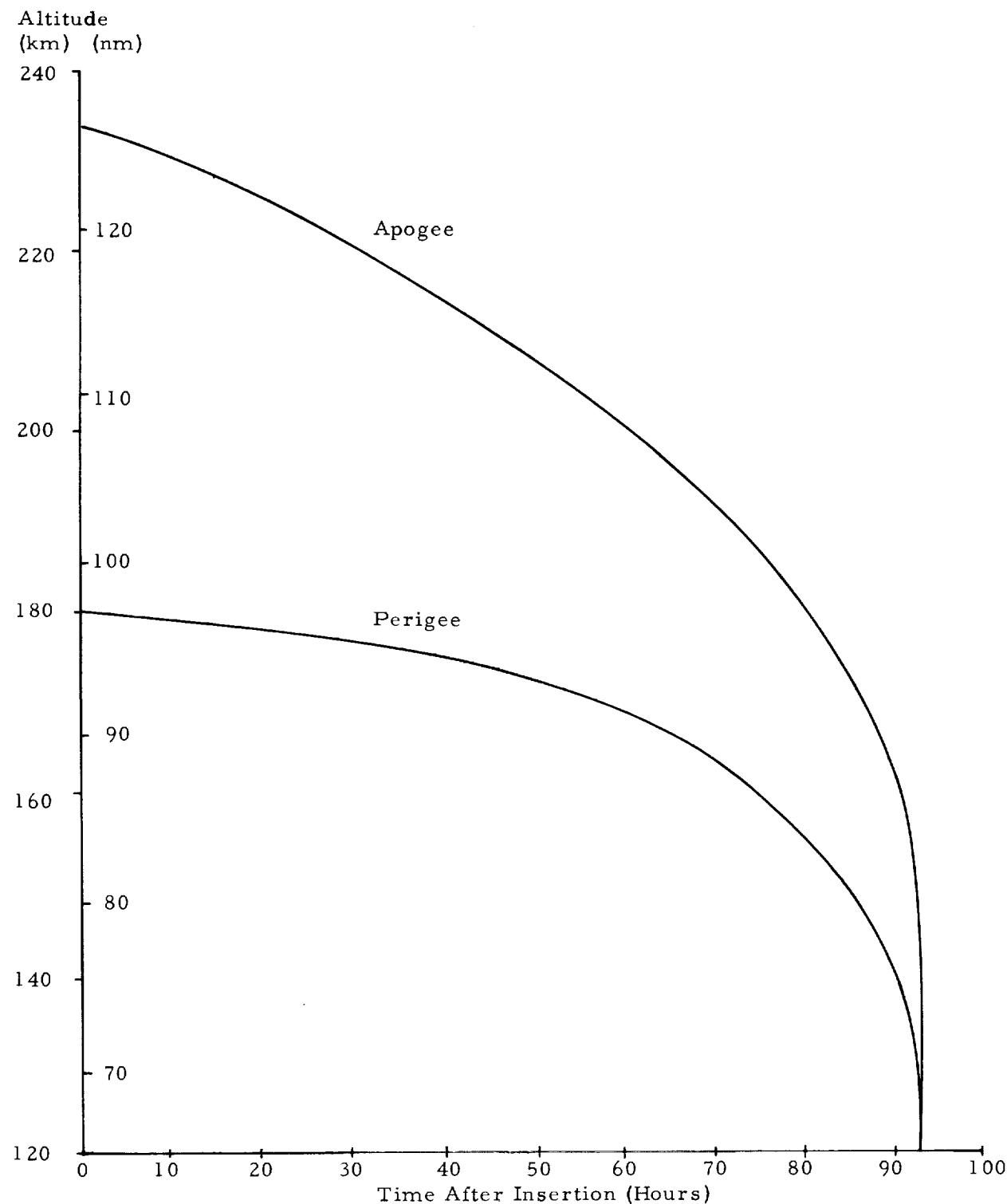


FIGURE 18 SA-7 APOGEE AND PERIGEE ALTITUDES

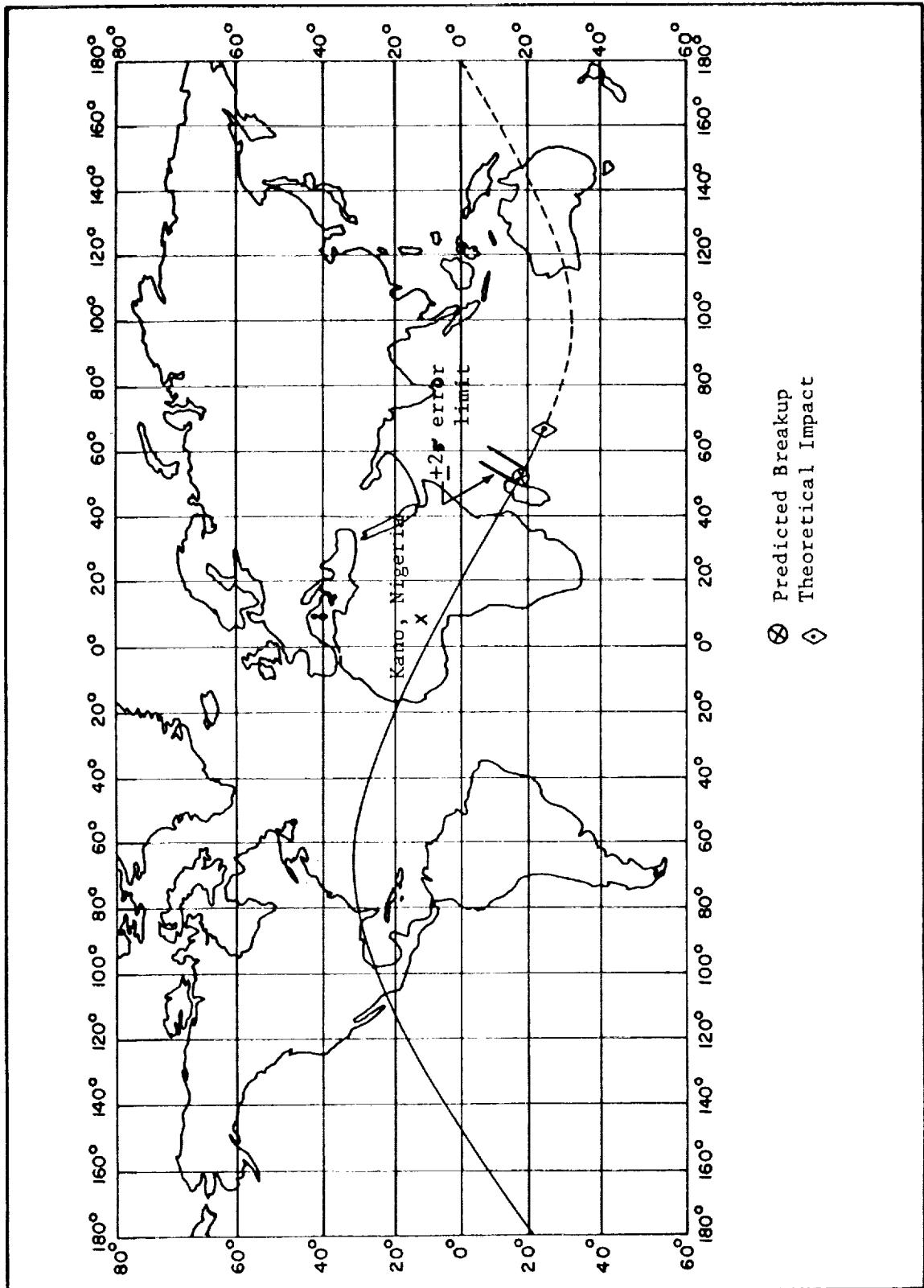


FIGURE 19 SA-7 FINAL ORBIT AND RE-ENTRY

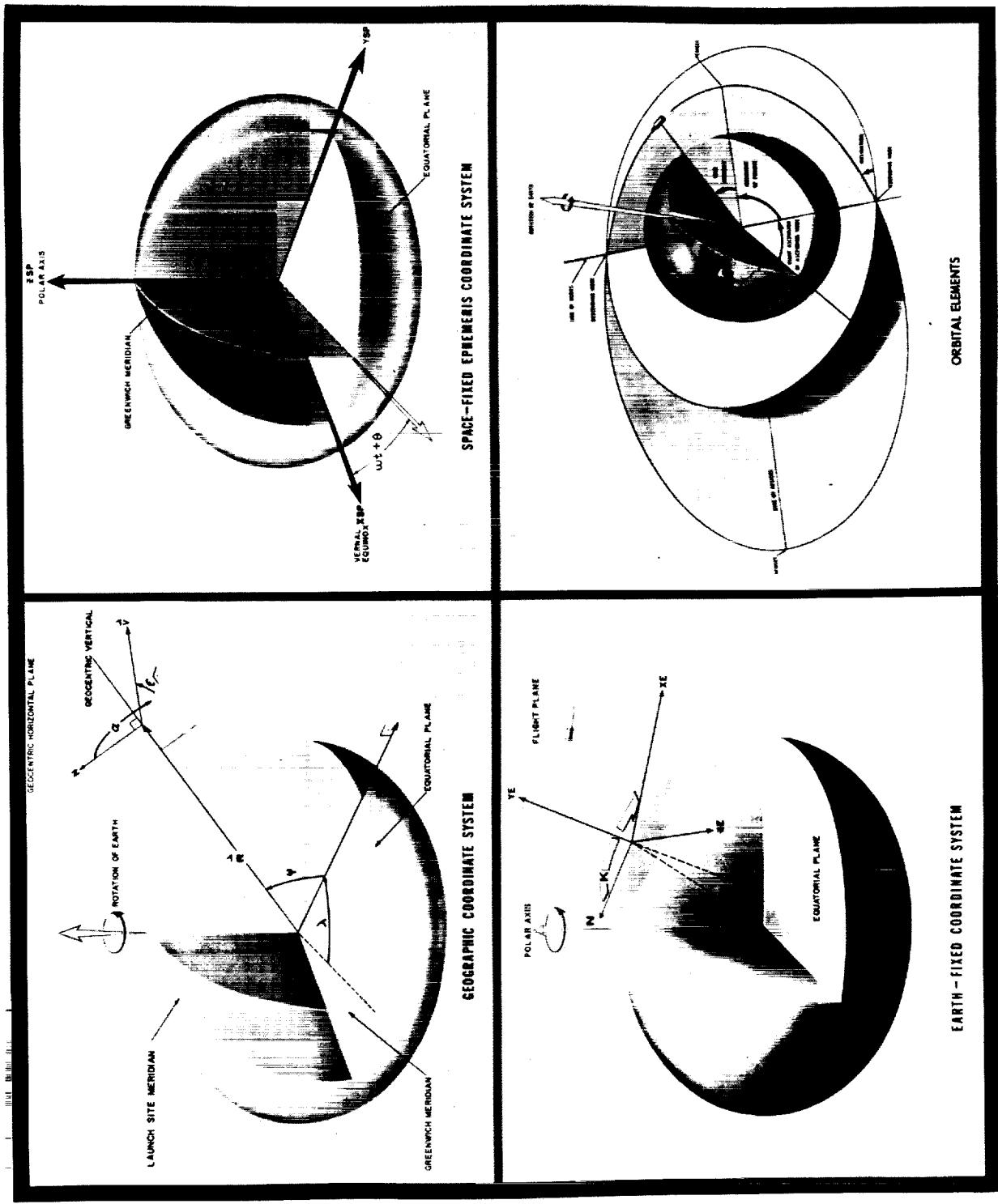


FIGURE 20 TRAJECTORY COORDINATE SYSTEMS

TABLE I TRACKING DATA SOURCES (POWERED FLIGHT)

<u>Data Source</u>	<u>Time Available (sec)</u>
Fixed Camera	0.00 - 19.166
Theodolite	5.60 - 61.40
Azusa	14.00 - 147.40
	153.40 - 214.50
	217.20 - 413.40
ODOP	1.10 - 126.90
	136.70 - 148.30
	164.10 - 320.00
MISTRAM	45.00 - 148.10
	153.00 - 349.70
	352.00 - 580.30
Radar Altimeter	163.72 - 631.00
GLOTRAC	170.00 - 403.30
Cape Kennedy (1.16) Radar (FPS-16)	10.00 - 73.20
	82.00 - 406.00
G. B. I (3.16) Radar (FPS-16)	77.00 - 550.00
San Salvador (5.16) Radar (FPS-16)	147.70 - 595.00
Grand Turk (7.18) Radar (TPQ-18)	181.00 - 401.00
	475.00 - 631.00
Bermuda (BDA) Radar (FPS-16)	388.00 - 412.00
	478.00 - 631.00
Patrick (0.18) Radar (FPQ-6) (tracked S-I booster after separation)	17.50 - 422.00

TABLE II TIMES OF EVENTS

Event	Range Time		
	Actual	Nominal	Act-Nom
First Motion		0. 06	
LO Signal (Umb Disc)		0. 26	
Guidance Detects LO	0. 27	0. 27	0
Guidance Computes Zero Time	0. 33	0. 33	0
Brakes Released	10. 96	10. 96	0
Load Ladders & Roll Command	11. 28	11. 28	0
Pitch Command	12. 88	12. 88	0
Roll Completed	26. 40	26. 35	0. 05
Lock Modules	136. 59	136. 59	0
Level Sense	139. 54	138. 93	0. 61
IECO	141. 54	140. 93	0. 61
OECO	147. 64	146. 93	0. 71
Ullage Rockets Ignite	148. 34	147. 63	0. 71
Separation	148. 44	147. 73	0. 71
Open S-IV Accumulators	149. 24	148. 53	0. 71
S-IV Start	150. 14	149. 43	0. 71
Jettison Ullageé Rockets & LES	160. 44	159. 73	0. 71
Introduce Guidance	165. 67		
Introduce Misalignment Corr.	172. 07		
Guidance Cutoff Signal	621. 375	619. 36	2. 015

TABLE III SIGNIFICANT TRAJECTORY PARAMETERS

Event			
First Motion	Range Time	0.06 sec	
Mach One	Total Inertial Acceleration	12.68 m/s ² (41.60 ft/s ²)	
Mach One	Range Time	55.2 sec	
Mach One	Altitude	7.18 km (23556 ft)	
Maximum Dynamic Pressure	Range Time	73.0 sec	
Maximum Dynamic Pressure	Dynamic Pressure	3.680 N/cm ² (768.6 lb/ft ²)	
Maximum Dynamic Pressure	Altitude	13.53 km (44390 ft)	
Maximum Total Inertial Acceleration (S-I Stage)	Range Time	141.66 sec	
Maximum Total Inertial Acceleration (S-I Stage)	Acceleration	57.98 m/s ² (190.22 ft/s ²)	
Maximum Earth-Fixed Velocity (S-I Stage)	Range Time	147.8 sec	
Maximum Earth-Fixed Velocity (S-I Stage)	Velocity	2703.7 m/s (8870.4 ft/s)	
Apex (S-I Stage)	Range Time	293.0 sec	
Apex (S-I Stage)	Altitude	159.41 km (522999 ft)	
Apex (S-I Stage)	Range	428.05 km (231.13 nm)	
Apex (S-I Stage)	Earth-Fixed Velocity	2360.1 m/s (7743.1 ft/s)	
Apex (S-IV Stage)	Range Time	408.0 sec	
Apex (S-IV Stage)	Altitude	210.35 km (690125 ft)	
Apex (S-IV Stage)	Range	914.44 km (493.76 nm)	
Apex (S-IV Stage)	Earth-Fixed Velocity	4302.8 m/s (14116.79 ft/s)	
Loss of Telemetry (S-I Stage)	Range Time	464.3 sec	
Loss of Telemetry (S-I Stage)	Altitude	38.6 km (126640 ft)	
Loss of Telemetry (S-I Stage)	Range	828.27 km (447.23 nm)	
Impact (S-I Stage)	Total Inertial Acceleration	-2.35 m/s ² (-7.71 ft/s ²)	
Impact (S-I Stage)	Elevation Angle From Pad	1.028 deg	
Impact (S-I Stage)	Range Time	536.8 sec	
Impact (S-I Stage)	Range	883.66 km (477.14 nm)	
Impact (S-I Stage)	Cross Range	12.40 km (6.695 nm)	
Impact (S-I Stage)	Geodetic Latitude	26.0942 deg	
Impact (S-I Stage)	Longitude	72.0617 deg	
Maximum Total Inertial Acceleration(S-IV Stage)	Range Time	621.42 sec	
Maximum Total Inertial Acceleration(S-IV Stage)	Acceleration	22.22 m/s ² (72.90 ft/s ²)	
Maximum Earth-Fixed Velocity (S-IV Stage)	Range Time	621.70 sec	
Maximum Earth-Fixed Velocity (S-IV Stage)	Velocity	7405.8 m/s (24297 ft/s)	

TABLE IV CUTOFF CONDITIONS

Parameter	IIECO	OEKO	S-IV CO (Guidance Signal)
Range Time	141.54 sec	147.64 sec	621.375 sec
Altitude	65.65 km (215387 ft)	72.90 km (239173 ft)	184.33 km (604757 ft)
Range	75.87 km (40.97 nm)	89.95 km (48.57 nm)	2084.84 km (1125.72 nm)
Cross Range, ZE	0.25 km (0.13 nm)	0.29 km (0.16 nm)	47.38 km (25.58 nm)
Cross Range Velocity, DZE	5.9 m/s (19.4 ft/s)	7.4 m/s (24.3 ft/s)	218.0 m/s (715.2 ft/s)
Earth-Fixed Velocity	2534.3 m/s (8314.6 ft/s)	2697.4 m/s (8849.7 ft/s)	7403.2 m/s (24288.7 ft/s)
Earth-Fixed Velocity Vector Elevation	27.61 deg	26.49 deg	0.07 deg
Earth-Fixed Velocity Vector Azimuth	105.43 deg	105.52 deg	115.10 deg
Space-Fixed Vel.	2895.8 m/s (9500.7 ft/s)	3062.0 m/s (10045.9 ft/s)	7807.8 m/s (25616.1 ft/s)
Total Inertial Acceleration	57.81 m/s ² (189.67 ft/s ²)	30.23 m/s ² (99.18 ft/s ²)	22.21 m/s ² (72.87 ft/s ²)

Earth-Fixed Velocity Accuracy

OECO	+ 0.3 m/s (0.7 ft/s)
S-IV CO	- 0.6 m/s (2.0 ft/s)
Altitude Accuracy	
OECO	+ 20 m (66 ft)
S-IV CO	- 100 m (328 ft)

TABLE V ORBITAL ELEMENTS AT INSERTION

Time	16:33:14.375 U.T.
Semi-major Axis	6585.32 km (3555.79 nm)
Eccentricity	0.00409149
Inclination	31.7516 deg
Right Ascension of Ascending Node	44.8717 deg
Argument of Perigee	118.1954 deg
True Anomaly	17.7117 deg
Mean Sidereal Time, 0 hr U.T. Sept 18, 1964	356.94439 deg
Space-Fixed Velocity	7810.44 m/s (25624.75 ft/s)
Azimuth of Space-Fixed Velocity (CW from North)	113.9638 deg
Flight Path Angle	0.07104 deg
Altitude from Earth center	6559.64 km (3541.92 nm)
Geocentric Latitude (North)	21.4795 deg
Longitude (East)	299.4550 deg

TABLE VI ORBITAL INSERTION PARAMETERS

	<u>Actual</u>	<u>Nominal</u>	<u>Actual Minus Nominal</u>
Time of Orbital Insertion (Range Time)	631.375 sec	629.352 sec	+ 2.023 sec
Space-Fixed Velocity	7810.44 m/s (25624.8 ft/s)	7807.67 m/s (25615.7 ft/s)	+ 2.77 m/s(9.1 ft/s)
Flight Path Angle	0.07 deg	0.07 deg	+ 0.00 deg
Altitude**	184.35 km (99.54 nm)	185.34 km (100.08 nm)	- 0.99 km (-0.54 nm)
Ground Range	2156.82 km (1164.59 nm)	2143.07 km(1157.17 nm)	+13.75 km (7.42 nm)
Apogee Altitude *	234.10 km (126.40 nm)	227.92 km (123.07 nm)	+ 6.18 km (3.33 nm)
Perigee Altitude *	180.21 km (97.31 nm)	180.95 km (97.71 nm)	- 0.74 km (-0.40 nm)
Period	88.64 min	88.58 min	+ 0.06 min
Inclination	31.75 deg	31.76 deg	- 0.01 deg
Excess Circular Velocity	15.2 m/s (49.9 ft/s)	13.0 m/s (42.7 ft/s)	+ 2.2 m/s (7.2 ft/s)
Lifetime	3.8 days	3.2 days	+ 0.6 days

* Apogee and perigee altitudes defined assuming a spherical Earth of radius 6378.165 km (3443.9336 nm).

** Altitude defined assuming an oblate Earth (Fischer Ellipsoid).

TABLE VII

SA-7 ORBITAL TRACKING SUMMARY

STATION	NUMBER OF VALID PASSES				
	9/18	9/19	9/20	9/21	9/22
Johannesburg, S. Africa (ST)	4	2		1	
Goldstone Lake, Calif. (ST)	1	1	1	1	
Lima, Peru (ST)	1	2	2	2	1
Santiago, Chile (ST)		2	1	1	
Woomera, Australia (ST)		3	2	1	1
Fort Myers, Florida (ST)		3	2	2	2
Quito, Ecuador (ST)		1		1	
Trinidad (N)	1	2	2		1
Moorestown (N)		4		1	
Ft. Stewart (I!)			1	1	
Pretoria, S. Africa (SA)	1	1			
Island Lagoon, Aus. (SA)				1	
Nainital, India (SA)			1		
Johannesburg, S. Africa (M)	1				
Woomera, Aus. (M)				1	

(ST) STADAN (Satellite Tracking and Data Acquisition Network) Station
 (N) NORAD Station
 (SA) Smithsonian Observatory Station
 (M) MOTS (Minitrack Optical Tracking Station)

TABLE VIII

SA-7 ORBITAL RADAR TRACKING SUMMARY

STATION	NUMBER OF VALID PASSES				
	9/18	9/19	9/20	9/21	9/22
Grand Turk Island	2		2	3	
Bermuda	1	1	2	3	1
Antigua	1	1			1
Ascension Island	2	1			
Pretoria, S. Africa	2				
Carnarvon, Australia	1	5	5	6	1
Hawaii	1			1	
Pt. Arguello, Calif.	1				
White Sands Proving Ground	2	3	3	4	
Eglin AFB, Florida		3	3	3	1
Merritt Island Launch Area	1			2	
Patrick AFB, Florida	1	5	4	3	2
Wallops Island, Virginia		2	3	3	2

- * Last beacon track by Hawaii on Rev 3 at 18/20:54 U.T.
- * Last skin track by Wallops Island on Rev 58 at 22/11:18:53 U.T.
- * Last vehicle contact 136 mc telemetry signal received by Kano, Nigeria on Rev 59 at 22/11:33:39Z
- * All tracking on 9/18 is beacon tracking

TABLE IX BOOSTER FREEFLIGHT TRAJECTORY

Time (sec)	Earth-Fixed Position			Earth-Fixed Velocity			Range (m)
	XE (m)	YE (m)	ZE (m)	DXE (m/s)	DYE (m/s)	DZE (m/s)	
160	120893	85907	410	2416	1048	1.1	87037
180	169135	105030	655	2409	865	14	107236
200	217238	120490	976	2401	682	18	124120
220	265181	132303	1373	2393	500	22	137701
240	312945	140485	1843	2384	319	25	147991
260	360515	145048	2383	2373	138	29	155000
280	407871	146002	2989	2362	-42	32	158737
300	454995	143352	3660	2350	-223	35	159202
320	501871	137100	4390	2337	-403	38	156397
340	548479	127243	5178	2323	-583	41	150319
360	594801	113776	6021	2309	-764	43	140963
380	640618	96690	6914	2293	-945	46	128319
400	686510	75973	7854	2276	-1127	48	112376
420	731856	51608	8838	2258	-1310	50	93120
440	776835	23575	9861	2239	-1494	52	70531
460	821397	-8132	10921	2215	-1676	54	44603
480	864367	-42606	11983	1936	-1649	49	16081
500	880539	-57240	12395	57	-117	2	3794
520	880896	-59422	12406	-3	-104	0	1681
536.8	880754	-61100	12404	-11	-96	0	0

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
FIRST MOTION						
0.060	0	32	0	0.	-0.	-0.
LIFTOFF SIGNAL						
0.260	0	32	0	0.0	0.6	-0.0
1.0	0	33	0	0.0	2.8	-0.0
2.0	0	38	0	0.0	5.9	-0.0
3.0	0	45	0	-0.0	9.2	-0.0
4.0	0	56	0	-0.1	12.6	0.0
5.0	0	71	0	-0.1	16.1	0.0
6.0	0	88	0	-0.1	19.7	0.0
7.0	0	110	0	-0.2	23.4	0.0
8.0	-0	135	0	-0.3	27.2	-0.0
9.0	-0	164	0	-0.3	31.0	-0.0
10.0	-0	197	0	-0.4	34.9	-0.0
11.0	-1	234	0	-0.5	38.9	-0.0
12.0	-1	275	0	-0.6	43.0	-0.0
13.0	-2	320	0	-0.7	47.2	-0.0
14.0	-3	369	0	-0.8	51.5	-0.0
15.0	-3	423	0	-0.9	55.9	-0.0
16.0	-4	481	0	-0.9	60.4	0.0
17.0	-5	544	0	-1.0	65.0	0.1
18.0	-6	611	0	-0.9	69.6	0.1
19.0	-7	683	0	-0.9	74.4	0.2
20.0	-8	760	0	-0.7	79.2	0.2
21.0	-9	842	0	-0.5	84.1	0.3
22.0	-9	928	1	-0.2	89.1	0.4
23.0	-10	1020	1	0.3	94.2	0.4
24.0	-9	1116	1	0.9	99.4	0.5
25.0	-8	1218	2	1.6	104.6	0.6
26.0	-6	1326	2	2.5	110.0	0.6
27.0	-3	1438	3	3.6	115.4	0.7
28.0	0	1557	4	4.9	120.9	0.7
29.0	5	1680	5	6.4	126.6	0.8
30.0	12	1810	5	8.0	132.3	0.8

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
31.0	21	1945	6	9.8	138.0	0.8
32.0	32	2086	7	11.8	143.9	0.9
33.0	44	2233	8	14.0	149.8	0.9
34.0	59	2385	9	16.4	155.8	0.9
35.0	77	2544	10	18.9	161.9	0.9
36.0	97	2709	11	21.7	168.1	0.9
37.0	120	2881	12	24.6	174.4	0.9
38.0	146	3058	13	27.7	180.7	1.0
39.0	175	3242	14	31.1	187.1	1.1
40.0	208	3432	15	34.6	193.6	1.2
41.0	244	3629	16	38.4	200.2	1.3
42.0	284	3833	18	42.3	206.8	1.4
43.0	328	4043	19	46.4	213.5	1.5
44.0	376	4260	21	50.8	220.3	1.5
45.0	429	4484	22	55.4	227.1	1.6
46.0	487	4714	24	60.2	233.9	1.6
47.0	549	4952	26	65.3	240.8	1.5
48.0	617	5196	27	70.6	247.8	1.5
49.0	690	5447	29	76.2	254.8	1.4
50.0	769	5706	30	82.0	261.9	1.3
51.0	854	5971	31	88.0	269.0	1.3
52.0	944	6244	33	94.2	276.1	1.3
53.0	1042	6523	34	100.6	283.2	1.2
54.0	1145	6810	35	107.1	290.3	1.2
55.0	1255	7104	37	113.7	297.1	1.2

MACH ONE

55.245	1283	7177	37	115.3	298.8	1.2
56.0	1372	7405	38	120.4	303.8	1.2
57.0	1496	7712	39	127.4	310.3	1.2
58.0	1627	8026	40	134.7	316.7	1.2
59.0	1765	8345	42	142.3	323.0	1.2
60.0	1911	8672	43	150.3	329.3	1.2
61.0	2065	9004	44	158.4	335.7	1.1
62.0	2227	9343	45	166.8	342.2	1.1
63.0	2398	9689	46	175.3	348.9	1.1
64.0	2578	10041	47	184.2	355.7	1.1
65.0	2766	10401	49	193.3	362.5	1.3

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
66.0	2964	10767	50	202.9	369.4	1.6
67.0	3172	11140	52	212.8	376.4	2.0
68.0	3389	11520	54	223.1	383.5	2.4
69.0	3617	11907	57	233.7	390.7	2.7
70.0	3856	12302	60	244.7	398.0	2.9
71.0	4107	12703	63	256.0	405.4	3.0
72.0	4368	13113	66	267.8	412.8	3.0

MAXIMUM DYNAMIC PRESSURE

73.000	4642	13529	69	279.9	420.3	3.0
74.0	4928	13954	72	292.5	427.9	3.0
75.0	5227	14385	75	305.5	435.5	3.0
76.0	5539	14825	78	318.9	443.3	3.0
77.0	5864	15273	81	332.6	451.3	2.9
78.0	6204	15728	84	346.6	459.4	2.8
79.0	6557	16192	86	360.9	467.7	2.6
80.0	6925	16664	89	375.7	476.1	2.5
81.0	7308	17144	91	390.8	484.6	2.4
82.0	7707	17633	94	406.3	493.3	2.3
83.0	8121	18131	96	422.3	502.0	2.2
84.0	8551	18638	98	438.7	510.8	2.0
85.0	8998	19153	100	455.6	519.7	1.9
86.0	9462	19678	102	472.9	528.8	1.7
87.0	9944	20211	104	490.6	538.0	1.6
88.0	10443	20754	105	508.7	547.3	1.6
89.0	10961	21306	106	527.2	556.7	1.5
90.0	11498	21868	107	546.2	566.2	1.5
91.0	12053	22440	108	565.6	575.7	1.4
92.0	12629	23021	108	585.5	585.4	1.4
93.0	13225	23612	110	605.8	595.1	1.3
94.0	13841	24212	111	626.6	604.8	1.2
95.0	14478	24822	112	647.9	614.6	1.2
96.0	15136	25441	113	669.6	624.5	1.2
97.0	15817	26071	114	691.7	634.5	1.3
98.0	16520	26711	116	714.3	644.5	1.3
99.0	17246	27360	117	737.4	654.7	1.4
100.0	17995	28020	119	760.9	664.8	1.4
101.0	18768	28691	120	785.0	675.1	1.5

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XF "	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
102.0	19565	29371	121	809.5	685.3	1.5
103.0	20387	30062	123	834.5	695.7	1.6
104.0	21234	30763	125	859.9	706.0	1.6
105.0	22107	31474	126	885.9	716.5	1.6
106.0	23006	32196	128	912.3	727.0	1.7
107.0	23931	32928	130	939.2	737.6	1.7
108.0	24884	33672	131	966.6	748.3	1.7
109.0	25865	34425	133	994.5	759.0	1.8
110.0	26873	35190	135	1023.0	769.8	1.9
111.0	27911	35965	137	1052.0	780.6	2.0
112.0	29977	36752	139	1081.6	791.5	2.1
113.0	30074	37549	141	1111.7	802.4	2.2
114.0	31201	38357	143	1142.4	813.3	2.2
115.0	32359	39176	145	1173.6	824.4	2.3
116.0	33548	40006	148	1205.4	835.5	2.4
117.0	34770	40847	150	1237.7	846.8	2.5
118.0	36024	41700	153	1270.6	858.2	2.6
119.0	37312	42564	155	1304.2	869.6	2.7
120.0	38633	43439	158	1338.3	881.1	2.7
121.0	39988	44327	161	1373.1	892.7	2.8
122.0	41379	45225	164	1408.5	904.3	2.9
123.0	42806	46136	167	1444.7	916.0	2.9
124.0	44269	47058	170	1481.4	927.8	3.1
125.0	45769	47991	173	1518.9	939.6	3.2
126.0	47307	48937	176	1557.1	951.6	3.4
127.0	48884	49895	180	1596.0	963.5	3.6
128.0	50500	50865	183	1635.7	975.5	3.7
129.0	52155	51847	187	1676.1	987.6	3.8
130.0	53852	52840	191	1717.4	999.7	3.9
131.0	55591	53846	195	1759.6	1011.8	4.0
132.0	57372	54864	199	1802.6	1024.0	4.1
133.0	59197	55895	203	1846.6	1036.2	4.2
134.0	61066	56937	207	1891.5	1048.4	4.3
135.0	62980	57993	211	1937.3	1060.6	4.5
136.0	64942	59059	216	1984.0	1072.9	4.6
137.0	65951	60137	221	2031.8	1085.4	4.9
138.0	67009	61228	226	2080.5	1097.9	5.1
139.0	71115	62332	231	2130.1	1110.9	5.3
140.0	73272	63449	237	2180.6	1124.3	5.6
141.0	75479	64579	243	2232.2	1138.2	5.8

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
INBOARD ENGINE CUTOFF						
141.540	76693	65195	246	2260.4	1145.9	5.9
142.0	77738	65724	249	2279.1	1150.6	6.0
143.0	80033	66875	255	2306.6	1153.8	6.2
144.0	82354	68030	262	2333.4	1156.6	6.5
145.0	84702	69187	269	2360.1	1159.5	6.7
146.0	87077	70348	276	2387.1	1162.4	7.0
147.0	89479	71511	283	2414.2	1165.4	7.3
OUTBOARD ENGINE CUTOFF						
147.640	91030	72257	288	2431.7	1167.4	7.4
148.0	91907	72677	290	2438.5	1167.1	7.5
149.0	94348	73840	299	2439.6	1158.6	7.8
150.0	95789	74993	308	2440.3	1149.7	8.0
155.0	109020	80640	350	2457.6	1111.8	9.0
160.0	121374	86116	397	2484.2	1078.6	9.7
165.0	133865	91428	448	2512.2	1046.3	10.6
170.0	146497	96577	503	2540.7	1013.7	11.8
175.0	159274	101560	571	2570.1	979.1	15.5
180.0	172199	106366	659	2600.0	943.5	19.6
185.0	185275	110994	766	2630.4	907.8	23.2
190.0	198503	115444	891	2660.8	872.1	26.6
195.0	211884	119714	1031	2691.6	836.4	29.6
200.0	225418	123807	1186	2722.5	801.0	32.4
205.0	239108	127724	1355	2753.5	765.8	34.9
210.0	252953	131466	1535	2784.8	730.9	37.3
215.0	266956	135033	1726	2816.2	696.1	39.3
220.0	281116	138426	1928	2847.9	661.4	41.3
225.0	295435	141646	2139	2879.9	626.8	43.1
230.0	309915	144693	2358	2912.2	592.2	44.7
235.0	324557	147567	2585	2944.8	557.6	46.2
240.0	339362	150268	2820	2977.5	523.0	47.8
245.0	354333	152797	3063	3010.7	488.6	49.1
250.0	369469	155153	3312	3044.1	454.3	50.5
255.0	384772	157339	3568	3077.4	420.0	51.8

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
260.0	400244	159353	3830	3111.2	385.9	53.1
265.0	415885	161198	4098	3145.2	352.0	54.4
270.0	431697	162873	4373	3179.5	318.1	55.6
275.0	447680	164378	4654	3214.0	284.1	56.9
280.0	463837	165715	4941	3248.7	250.6	58.1
285.0	480168	166883	5235	3283.7	217.0	59.3
290.0	496675	167884	5535	3319.0	183.4	60.6
295.0	513358	168717	5841	3354.5	149.9	61.9
300.0	530221	169382	6154	3390.4	116.3	63.3
305.0	547263	169880	6474	3426.6	83.0	64.6
310.0	564486	170211	6800	3462.9	49.8	65.9
315.0	581893	170376	7133	3499.7	16.4	67.3
320.0	599483	170374	7474	3536.7	-17.0	68.8
325.0	617261	170205	7822	3574.2	-50.4	70.3
330.0	635226	169869	8177	3612.0	-84.0	71.8
335.0	653382	169365	8540	3650.3	-117.6	73.4
340.0	671730	168693	8910	3688.9	-151.1	74.9
345.0	690272	167853	9289	3727.9	-184.7	76.6
350.0	709010	166845	9676	3767.4	-218.4	78.2
355.0	727946	165668	10071	3807.2	-252.1	79.9
360.0	747083	164323	10475	3847.5	-286.0	81.6
365.0	766422	162808	10888	3888.3	-319.9	83.4
370.0	785966	161123	11309	3929.4	-354.0	85.1
375.0	805717	159268	11739	3971.0	-387.8	87.0
380.0	825677	157243	12179	4013.0	-421.8	88.8
385.0	845848	155049	12628	4055.6	-455.9	90.7
390.0	866233	152683	13086	4098.6	-490.2	92.6
395.0	885835	150146	13554	4142.1	-524.5	94.6
400.0	907655	147437	14032	4186.0	-559.1	96.5
405.0	928696	144555	14519	4230.6	-593.6	98.5
410.0	949961	141500	15016	4275.7	-628.3	100.4
415.0	971453	138271	15523	4321.3	-663.1	102.5
420.0	993175	134868	16040	4367.6	-698.1	104.5
425.0	1015130	131289	16568	4414.5	-733.5	106.5
430.0	1037321	127532	17106	4462.1	-769.1	108.7
435.0	1059752	123597	17655	4510.4	-805.0	110.8
440.0	1082426	119481	18214	4559.3	-841.0	113.0
445.0	1105346	115186	18785	4608.8	-877.2	115.2
450.0	1128515	110709	19366	4659.0	-913.5	117.5
455.0	1151936	106050	19959	4709.8	-949.9	119.7

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XF M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
460.0	1175613	101209	20563	4761.2	-986.5	121.9
465.0	1199549	96184	21179	4813.4	-1023.1	124.2
470.0	1223748	90976	21806	4866.4	-1059.9	126.6
475.0	1248214	85584	22445	4920.0	-1097.1	129.0
480.0	1272950	80005	23096	4974.6	-1134.5	131.4
485.0	1297961	74238	23760	5030.0	-1172.1	134.0
490.0	1323251	68282	24437	5086.3	-1210.2	136.6
495.0	1348825	62135	25127	5143.5	-1248.6	139.2
500.0	1374688	55794	25830	5201.8	-1287.7	141.9
505.0	1400844	49257	26546	5261.0	-1327.2	144.4
510.0	1427299	42521	27275	5321.1	-1366.8	147.1
515.0	1454056	35587	28017	5382.3	-1406.8	149.9
520.0	1481123	28452	28774	5444.5	-1447.2	152.7
525.0	1508503	21113	29544	5507.9	-1488.0	155.4
530.0	1536203	13571	30328	5572.4	-1529.1	158.3
535.0	1564227	5822	31126	5637.9	-1570.6	161.1
540.0	1592583	-2135	31939	5704.7	-1612.4	164.0
545.0	1621276	-10303	32766	5772.8	-1654.7	166.9
550.0	1650312	-18683	33608	5842.1	-1697.4	169.9
555.0	1679699	-27279	34464	5912.8	-1740.7	172.9
560.0	1709442	-36092	35337	5984.9	-1784.5	176.0
565.0	1739550	-45125	36224	6058.4	-1828.7	179.1
570.0	1770029	-54381	37127	6133.5	-1873.5	182.2
575.0	1800888	-63862	38046	6210.2	-1919.1	185.4
580.0	1832134	-73572	38982	6288.5	-1965.1	188.7
585.0	1863776	-83515	39934	6368.6	-2011.9	192.0
590.0	1895822	-93694	40903	6450.3	-2059.4	195.4
595.0	1928282	-104111	41889	6533.9	-2107.5	198.9
600.0	1961164	-114771	42892	6619.4	-2156.4	202.4
605.0	1994479	-125677	43912	6706.8	-2206.1	205.8
610.0	2028235	-136834	44950	6796.3	-2256.8	209.5
615.0	2062445	-148247	46007	6888.0	-2308.4	213.1
620.0	2097118	-159920	47083	6981.9	-2361.0	216.9

S-IV STAGE GUIDANCE CUTOFF

621.375	2106735	-163176	47382	7008.3	-2375.7	218.0
625.0	2132133	-171842	48174	7001.2	-2404.6	219.3
630.0	2167105	-183964	49275	6987.5	-2444.0	221.0

TABLE X
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE M	YE M	ZE M	DXE M/S	DYE M/S	DZE M/S
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INSERTION

631.375	2176710	-187332	49579	6983.7	-2454.8	221.4
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TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
FIRST MOTION						
0.060	-5355.084	1664.680	3028.450	-121.4	-390.5	0.
LIFTOFF SIGNAL						
0.260	-5355.108	1664.603	3028.450	-121.9	-390.4	0.3
1.0	-5355.199	1664.314	3028.450	-123.7	-389.8	1.3
2.0	-5355.324	1663.925	3028.452	-126.3	-389.0	2.9
3.0	-5355.452	1663.536	3028.456	-129.0	-388.1	4.4
4.0	-5355.582	1663.148	3028.461	-131.9	-387.2	6.0
5.0	-5355.715	1662.762	3028.468	-134.7	-386.3	7.7
6.0	-5355.852	1662.376	3028.477	-137.7	-385.3	9.4
7.0	-5355.991	1661.991	3028.487	-140.7	-384.3	11.2
8.0	-5356.133	1661.607	3028.499	-143.8	-383.3	13.0
9.0	-5356.278	1661.225	3028.513	-147.0	-382.2	14.9
10.0	-5356.427	1660.843	3028.529	-150.2	-381.2	16.8
11.0	-5356.579	1660.462	3028.547	-153.6	-380.1	18.7
12.0	-5356.734	1660.083	3028.566	-156.9	-378.9	20.7
13.0	-5356.893	1659.704	3028.588	-160.4	-377.8	22.8
14.0	-5357.055	1659.327	3028.612	-163.9	-376.6	24.8
15.0	-5357.220	1658.951	3028.638	-167.6	-375.4	26.9
16.0	-5357.390	1658.576	3028.666	-171.3	-374.2	29.0
17.0	-5357.563	1658.203	3028.696	-175.1	-372.9	31.2
18.0	-5357.740	1657.830	3028.728	-179.0	-371.7	33.4
19.0	-5357.921	1657.459	3028.763	-183.0	-370.6	35.6
20.0	-5358.106	1657.089	3028.799	-187.1	-369.4	37.8
21.0	-5358.295	1656.720	3028.838	-191.3	-368.3	40.0
22.0	-5358.488	1656.353	3028.880	-195.6	-367.3	42.3
23.0	-5358.686	1655.986	3028.923	-200.1	-366.4	44.6
24.0	-5358.888	1655.620	3028.969	-204.7	-365.6	46.8
25.0	-5359.095	1655.255	3029.017	-209.4	-364.9	49.1
26.0	-5359.307	1654.891	3029.067	-214.2	-364.3	51.4
27.0	-5359.524	1654.527	3029.120	-219.2	-363.9	53.7
28.0	-5359.746	1654.163	3029.175	-224.4	-363.6	56.0
29.0	-5359.972	1653.800	3029.232	-229.7	-363.4	58.4
30.0	-5360.205	1653.437	3029.291	-235.1	-363.4	60.7

TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
31.0	-5360.443	1653.073	3029.353	-240.7	-363.5	63.0
32.0	-5360.686	1652.710	3029.417	-246.4	-363.8	65.3
33.0	-5360.935	1652.346	3029.484	-252.2	-364.3	67.6
34.0	-5361.191	1651.982	3029.553	-258.2	-364.8	70.0
35.0	-5361.452	1651.616	3029.624	-264.3	-365.5	72.3
36.0	-5361.719	1651.251	3029.697	-270.6	-366.4	74.6
37.0	-5361.993	1650.884	3029.773	-277.0	-367.4	76.9
38.0	-5362.273	1650.516	3029.851	-283.6	-368.5	79.1
39.0	-5362.560	1650.148	3029.931	-290.3	-369.8	81.3
40.0	-5362.854	1649.777	3030.014	-297.2	-371.3	83.5
41.0	-5363.154	1649.405	3030.099	-304.3	-372.9	85.8
42.0	-5363.462	1649.032	3030.185	-311.4	-374.7	88.0
43.0	-5363.777	1648.657	3030.275	-318.7	-376.6	90.2
44.0	-5364.099	1648.279	3030.366	-326.1	-378.8	92.3
45.0	-5364.430	1647.899	3030.459	-333.7	-381.1	94.5
46.0	-5364.767	1647.517	3030.555	-341.4	-383.7	96.7
47.0	-5365.112	1647.132	3030.653	-349.2	-386.5	98.9
48.0	-5365.465	1646.744	3030.753	-357.1	-389.5	101.1
49.0	-5365.826	1646.354	3030.855	-365.2	-392.6	103.2
50.0	-5366.196	1645.960	3030.959	-373.4	-396.0	105.3
51.0	-5366.573	1645.562	3031.066	-381.7	-399.6	107.4
52.0	-5366.959	1645.161	3031.174	-390.2	-403.3	109.4
53.0	-5367.353	1644.756	3031.285	-398.6	-407.2	111.4
54.0	-5367.756	1644.347	3031.397	-407.1	-411.2	113.3
55.0	-5368.168	1643.934	3031.511	-415.5	-415.3	115.1

MACH ZONE

55.245	-5368.270	1643.832	3031.539	-417.6	-416.4	115.5
56.0	-5368.587	1643.517	3031.627	-423.8	-419.7	116.7
57.0	-5369.015	1643.095	3031.745	-432.1	-424.3	118.2
58.0	-5369.451	1642.669	3031.864	-440.3	-429.2	119.6
59.0	-5369.896	1642.237	3031.984	-448.6	-434.4	120.9
60.0	-5370.349	1641.801	3032.106	-457.0	-439.8	122.1
61.0	-5370.810	1641.358	3032.228	-465.6	-445.5	123.4
62.0	-5371.280	1640.910	3032.352	-474.4	-451.3	124.6
63.0	-5371.759	1640.456	3032.478	-483.4	-457.3	125.9
64.0	-5372.247	1639.996	3032.604	-492.6	-463.4	127.0
65.0	-5372.744	1639.529	3032.732	-502.1	-469.8	128.1

TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
66.0	-5373.251	1639.057	3032.860	-511.8	-476.4	128.9
67.0	-5373.768	1638.577	3032.990	-521.7	-483.4	129.7
68.0	-5374.295	1638.090	3033.120	-531.9	-490.6	130.4
69.0	-5374.832	1637.596	3033.251	-542.3	-498.2	131.2
70.0	-5375.379	1637.094	3033.383	-552.8	-506.0	132.0
71.0	-5375.938	1636.584	3033.515	-563.5	-514.2	132.9
72.0	-5376.507	1636.066	3033.649	-574.4	-522.8	133.7
MAXIMUM DYNAMIC PRESSURE						
73.000	-5377.087	1635.539	3033.783	-585.6	-531.8	134.6
74.0	-5377.678	1635.003	3033.918	-596.9	-541.1	135.3
75.0	-5378.281	1634.457	3034.054	-608.5	-550.7	136.0
76.0	-5378.895	1633.902	3034.190	-620.3	-560.7	136.7
77.0	-5379.522	1633.336	3034.327	-632.4	-570.9	137.5
78.0	-5380.160	1632.760	3034.465	-644.8	-581.4	138.3
79.0	-5380.811	1632.173	3034.604	-657.3	-592.2	139.1
80.0	-5381.475	1631.576	3034.743	-670.2	-603.2	139.9
81.0	-5382.152	1630.967	3034.884	-683.3	-614.6	140.6
82.0	-5382.842	1630.347	3035.025	-696.6	-626.3	141.3
83.0	-5383.546	1629.715	3035.167	-710.2	-638.4	141.9
84.0	-5384.263	1629.071	3035.309	-724.1	-650.9	142.5
85.0	-5384.994	1628.413	3035.452	-738.2	-663.8	143.1
86.0	-5385.740	1627.743	3035.595	-752.6	-677.0	143.6
87.0	-5386.499	1627.060	3035.739	-767.3	-690.5	144.0
88.0	-5387.274	1626.363	3035.883	-782.2	-704.3	144.4
89.0	-5388.064	1625.651	3036.029	-797.4	-718.5	144.7
90.0	-5388.869	1624.926	3036.175	-812.9	-733.1	145.0
91.0	-5389.690	1624.185	3036.321	-828.6	-748.0	145.2
92.0	-5390.527	1623.429	3036.467	-844.5	-763.3	145.3
93.0	-5391.380	1622.658	3036.612	-860.7	-779.1	145.4
94.0	-5392.249	1621.871	3036.758	-877.0	-795.2	145.4
95.0	-5393.134	1621.068	3036.903	-893.6	-811.7	145.2
96.0	-5394.036	1620.247	3037.048	-910.5	-828.6	145.0
97.0	-5394.956	1619.411	3037.193	-927.7	-845.8	144.7
98.0	-5395.892	1618.556	3037.338	-945.1	-863.5	144.3
99.0	-5396.846	1617.683	3037.482	-962.7	-881.5	143.9
100.0	-5397.818	1616.793	3037.626	-980.5	-899.9	143.3
101.0	-5398.807	1615.884	3037.769	-998.6	-918.8	142.7

TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
102.0	-5399.815	1614.955	3037.911	-1016.9	-938.1	142.0
103.0	-5400.842	1614.007	3038.053	-1035.4	-957.8	141.2
104.0	-5401.887	1613.040	3038.194	-1054.2	-977.9	140.3
105.0	-5402.951	1612.052	3038.334	-1073.2	-998.4	139.4
106.0	-5404.033	1611.043	3038.473	-1092.5	-1019.4	138.4
107.0	-5405.136	1610.013	3038.611	-1112.0	-1040.7	137.3
108.0	-5406.258	1608.962	3038.748	-1131.8	-1062.5	136.1
109.0	-5407.400	1607.888	3038.883	-1151.8	-1084.8	134.9
110.0	-5408.562	1606.792	3039.018	-1172.1	-1107.4	133.5
111.0	-5409.744	1605.673	3039.150	-1192.6	-1130.6	132.0
112.0	-5410.947	1604.531	3039.282	-1213.4	-1154.3	130.3
113.0	-5412.172	1603.364	3039.411	-1234.4	-1178.4	128.6
114.0	-5413.417	1602.174	3039.539	-1255.7	-1203.1	126.8
115.0	-5414.683	1600.958	3039.665	-1277.3	-1228.2	124.9
116.0	-5415.972	1599.717	3039.789	-1299.2	-1253.7	123.0
117.0	-5417.282	1598.450	3039.911	-1321.4	-1279.8	120.9
118.0	-5418.615	1597.158	3040.031	-1343.9	-1306.3	118.8
119.0	-5419.970	1595.838	3040.149	-1366.7	-1333.4	116.5
120.0	-5421.340	1594.491	3040.264	-1389.8	-1361.0	114.2
121.0	-5422.750	1593.116	3040.377	-1413.2	-1389.2	111.8
122.0	-5424.176	1591.712	3040.488	-1436.9	-1417.9	109.2
123.0	-5425.625	1590.290	3040.596	-1460.9	-1447.2	106.5
124.0	-5427.098	1588.817	3040.701	-1485.3	-1477.1	103.7
125.0	-5428.596	1587.325	3040.803	-1510.0	-1507.6	100.7
126.0	-5430.119	1585.802	3040.903	-1535.0	-1538.7	97.5
127.0	-5431.667	1584.247	3040.999	-1560.4	-1570.4	94.3
128.0	-5433.240	1582.661	3041.091	-1586.1	-1602.8	90.9
129.0	-5434.839	1581.042	3041.181	-1612.1	-1636.0	87.4
130.0	-5436.465	1579.389	3041.266	-1638.5	-1669.8	83.7
131.0	-5438.116	1577.702	3041.348	-1665.2	-1704.5	79.8
132.0	-5439.704	1575.980	3041.426	-1692.3	-1739.9	75.8
133.0	-5441.502	1574.222	3041.500	-1719.8	-1776.1	71.5
134.0	-5443.236	1572.427	3041.569	-1747.6	-1813.1	67.0
135.0	-5444.999	1570.595	3041.634	-1775.9	-1851.0	62.3
136.0	-5446.788	1568.723	3041.693	-1804.6	-1889.6	57.4
137.0	-5448.608	1566.813	3041.747	-1833.8	-1929.2	52.3
138.0	-5450.456	1564.863	3041.796	-1863.5	-1969.5	47.0
139.0	-5452.335	1562.871	3041.840	-1893.8	-2010.5	41.8
140.0	-5454.244	1560.838	3041.878	-1925.0	-2052.3	36.4
141.0	-5456.185	1558.763	3041.911	-1956.9	-2094.9	31.2

TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
INBOARD ENGINE CUTOFF						
141.540	-5457.246	1557.625	3041.927	-1974.4	-2118.1	28.3
142.0	-5458.158	1556.647	3041.939	-1985.7	-2133.6	26.2
143.0	-5460.150	1554.500	3041.962	-1999.0	-2157.6	21.4
144.0	-5462.156	1552.329	3041.980	-2011.8	-2180.8	16.4
145.0	-5464.174	1550.136	3041.994	-2024.6	-2204.1	11.5
146.0	-5466.205	1547.918	3042.002	-2037.6	-2227.6	6.5
147.0	-5468.249	1545.678	3042.005	-2050.6	-2251.2	1.5
OUTBOARD ENGINE CUTOFF						
147.640	-5469.564	1544.232	3042.005	-2059.0	-2266.3	-1.6
148.0	-5470.306	1543.414	3042.004	-2061.4	-2272.5	-3.4
149.0	-5472.365	1541.139	3041.996	-2054.4	-2275.9	-7.9
150.0	-5474.416	1538.860	3041.985	-2047.0	-2278.9	-12.5
155.0	-5484.574	1527.412	3041.865	-2020.8	-2304.9	-35.4
160.0	-5494.631	1515.804	3041.632	-2002.1	-2338.1	-57.9
165.0	-5504.597	1504.028	3041.286	-1984.6	-2372.2	-80.4
170.0	-5514.476	1492.081	3040.826	-1967.2	-2406.7	-103.6
175.0	-5524.268	1479.961	3040.243	-1949.5	-2441.5	-129.9
180.0	-5533.970	1467.665	3039.525	-1931.1	-2476.9	-157.2
185.0	-5543.579	1455.191	3038.672	-1912.6	-2512.9	-184.2
190.0	-5553.095	1442.537	3037.683	-1894.0	-2548.9	-211.0
195.0	-5562.519	1429.701	3036.561	-1875.4	-2585.4	-237.6
200.0	-5571.849	1416.683	3035.307	-1857.0	-2622.0	-263.9
205.0	-5581.088	1403.481	3033.922	-1838.6	-2658.7	-290.0
210.0	-5590.235	1390.095	3032.408	-1820.5	-2695.7	-315.7
215.0	-5599.292	1376.523	3030.765	-1802.4	-2732.9	-341.2
220.0	-5608.259	1362.765	3028.995	-1784.4	-2770.3	-366.7
225.0	-5617.136	1348.819	3027.099	-1766.5	-2807.9	-392.0
230.0	-5625.923	1334.685	3025.075	-1748.6	-2845.9	-417.3
235.0	-5634.621	1320.360	3022.926	-1730.8	-2884.2	-442.5
240.0	-5643.230	1305.842	3020.650	-1712.9	-2922.6	-467.8
245.0	-5651.750	1291.133	3018.248	-1695.3	-2961.4	-492.9
250.0	-5660.183	1276.229	3015.720	-1677.9	-3000.3	-518.1
255.0	-5668.527	1261.131	3013.067	-1660.3	-3039.2	-543.1

TABLE XI
SPACE-FIXED EPHemeris Positions and Velocities

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
260.0	-5676.786	1245.836	3010.289	-1643.1	-3078.4	-568.1
265.0	-5684.958	1230.346	3007.386	-1626.0	-3117.8	-593.2
270.0	-5693.045	1214.658	3004.357	-1608.9	-3157.3	-618.2
275.0	-5701.048	1198.772	3001.203	-1592.0	-3197.1	-643.4
280.0	-5708.966	1182.687	2997.924	-1575.4	-3237.0	-668.3
285.0	-5716.800	1166.402	2994.520	-1558.8	-3277.0	-693.3
290.0	-5724.553	1149.916	2990.990	-1542.2	-3317.4	-718.5
295.0	-5732.223	1133.228	2987.334	-1525.9	-3358.0	-743.7
300.0	-5739.811	1116.336	2983.552	-1509.5	-3398.7	-769.1
305.0	-5747.318	1099.239	2979.643	-1493.5	-3439.7	-794.3
310.0	-5754.745	1081.939	2975.608	-1477.5	-3480.8	-819.6
315.0	-5762.093	1064.431	2971.446	-1461.6	-3522.3	-845.1
320.0	-5769.361	1046.716	2967.157	-1445.7	-3564.0	-870.7
325.0	-5776.550	1028.791	2962.739	-1430.0	-3606.0	-896.4
330.0	-5783.660	1010.655	2958.191	-1414.2	-3648.4	-922.4
335.0	-5790.692	992.306	2953.514	-1398.5	-3691.1	-948.5
340.0	-5797.646	973.743	2948.707	-1383.0	-3734.2	-974.5
345.0	-5804.522	954.963	2943.768	-1367.6	-3777.5	-1000.9
350.0	-5811.321	935.967	2938.697	-1352.2	-3821.2	-1027.3
355.0	-5818.044	916.750	2933.494	-1336.9	-3865.3	-1053.9
360.0	-5824.689	897.312	2928.157	-1321.5	-3909.8	-1080.8
365.0	-5831.259	877.651	2922.686	-1306.3	-3954.7	-1107.7
370.0	-5837.753	857.764	2917.079	-1291.2	-4000.0	-1134.8
375.0	-5844.171	837.650	2911.337	-1276.3	-4045.5	-1162.0
380.0	-5850.514	817.307	2905.459	-1261.4	-4091.5	-1189.3
385.0	-5856.784	796.734	2899.443	-1246.5	-4137.9	-1216.9
390.0	-5862.979	775.927	2893.289	-1231.7	-4184.8	-1244.7
395.0	-5869.101	754.886	2886.995	-1217.0	-4232.1	-1272.6
400.0	-5875.148	733.606	2880.562	-1202.2	-4279.8	-1300.7
405.0	-5881.122	712.087	2873.987	-1187.6	-4328.0	-1329.1
410.0	-5887.023	690.324	2867.271	-1173.0	-4376.8	-1357.5
415.0	-5892.852	668.318	2860.411	-1158.5	-4426.0	-1386.3
420.0	-5898.607	646.063	2853.407	-1144.0	-4475.8	-1415.3
425.0	-5904.291	623.558	2846.258	-1129.4	-4526.3	-1444.5
430.0	-5909.901	600.799	2838.961	-1114.8	-4577.5	-1474.2
435.0	-5915.439	577.783	2831.515	-1100.2	-4629.2	-1504.2
440.0	-5920.903	554.506	2823.919	-1085.7	-4681.5	-1534.3
445.0	-5926.296	530.966	2816.171	-1071.3	-4734.4	-1564.7
450.0	-5931.616	507.161	2808.271	-1056.9	-4787.9	-1595.4
455.0	-5936.864	483.087	2800.217	-1042.6	-4841.9	-1626.3

TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
460.0	-5942.041	458.741	2792.008	-1028.3	-4896.6	-1657.3
465.0	-5947.147	434.120	2783.644	-1014.3	-4951.8	-1688.6
470.0	-5952.183	409.222	2775.121	-1000.3	-5007.9	-1720.3
475.0	-5957.150	384.041	2766.440	-986.3	-5064.5	-1752.2
480.0	-5962.046	358.575	2757.598	-972.4	-5122.0	-1784.6
485.0	-5966.874	332.819	2748.593	-958.5	-5180.3	-1817.3
490.0	-5971.632	306.771	2739.423	-944.6	-5239.4	-1850.5
495.0	-5976.320	280.423	2730.086	-930.6	-5299.5	-1884.1
500.0	-5980.937	253.774	2720.580	-916.5	-5360.6	-1918.3
505.0	-5985.484	226.816	2710.902	-902.2	-5422.7	-1952.8
510.0	-5989.959	199.545	2701.051	-888.2	-5485.5	-1987.6
515.0	-5994.364	171.959	2691.025	-874.2	-5549.4	-2023.1
520.0	-5998.700	144.050	2680.820	-860.1	-5614.3	-2058.8
525.0	-6002.965	115.814	2670.435	-846.1	-5680.3	-2095.1
530.0	-6007.161	87.246	2659.869	-832.2	-5747.3	-2131.8
535.0	-6011.287	58.340	2649.118	-818.2	-5815.3	-2168.9
540.0	-6015.343	29.091	2638.179	-804.4	-5884.6	-2206.5
545.0	-6019.331	-0.507	2627.052	-790.7	-5955.0	-2244.7
550.0	-6023.249	-30.461	2615.732	-776.9	-6026.6	-2283.4
555.0	-6027.099	-60.776	2604.217	-763.2	-6099.6	-2322.7
560.0	-6030.880	-91.459	2592.505	-749.4	-6174.0	-2362.6
565.0	-6034.592	-122.517	2580.591	-735.8	-6249.6	-2403.1
570.0	-6038.236	-153.958	2568.473	-722.1	-6326.9	-2444.2
575.0	-6041.812	-185.790	2556.147	-708.3	-6405.6	-2486.1
580.0	-6045.320	-218.018	2543.610	-694.7	-6485.9	-2528.7
585.0	-6048.759	-250.652	2530.858	-681.0	-6568.0	-2572.1
590.0	-6052.129	-283.700	2517.887	-667.3	-6651.7	-2616.2
595.0	-6055.430	-317.171	2504.694	-653.6	-6737.1	-2661.1
600.0	-6058.663	-351.074	2491.274	-639.8	-6824.4	-2706.9
605.0	-6061.827	-385.418	2477.624	-626.0	-6913.6	-2753.4
610.0	-6064.922	-420.213	2463.738	-612.1	-7004.8	-2801.1
615.0	-6067.948	-455.469	2449.611	-598.1	-7098.2	-2849.7
620.0	-6070.903	-491.198	2435.238	-584.0	-7193.9	-2899.4

S-IV STAGE GUIDANCE CUTOFF

621.375	-6071.704	-501.107	2431.243	-580.1	-7220.6	-2913.3
625.0	-6073.752	-527.287	2420.656	-549.8	-7220.5	-2926.6
630.0	-6076.394	-563.380	2405.980	-506.9	-7216.7	-2943.7

TABLE XI
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP KM	YSP KM	ZSP KM	DXSP M/S	DYSP M/S	DZSP M/S
INSERTION						
631.375	-6077.082	-573.302	2401.929	-495.1	-7215.6	-2948.4

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TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
FIRST MOTION						
0.060	0.03	2.88	-0.03	-2.40	0.69	1.40
LIFTOFF SIGNAL						
0.260	0.02	2.93	-0.02	-2.44	0.71	1.41
1.0	0.00	3.07	-0.01	-2.55	0.77	1.47
2.0	-0.02	3.22	0.01	-2.68	0.83	1.54
3.0	-0.03	3.35	0.01	-2.78	0.88	1.60
4.0	-0.04	3.45	0.01	-2.87	0.91	1.65
5.0	-0.04	3.55	0.00	-2.94	0.94	1.70
6.0	-0.05	3.63	-0.00	-3.01	0.96	1.75
7.0	-0.06	3.72	-0.01	-3.08	0.99	1.79
8.0	-0.06	3.80	-0.01	-3.14	1.01	1.84
9.0	-0.07	3.89	-0.01	-3.21	1.04	1.88
10.0	-0.08	3.97	-0.01	-3.28	1.07	1.93
11.0	-0.09	4.06	-0.01	-3.35	1.11	1.97
12.0	-0.10	4.15	-0.00	-3.43	1.13	2.01
13.0	-0.10	4.24	0.01	-3.51	1.16	2.04
14.0	-0.09	4.34	0.01	-3.59	1.18	2.08
15.0	-0.08	4.43	0.02	-3.68	1.20	2.11
16.0	-0.05	4.52	0.03	-3.77	1.20	2.14
17.0	-0.02	4.61	0.04	-3.86	1.20	2.17
18.0	0.03	4.70	0.05	-3.96	1.18	2.19
19.0	0.10	4.79	0.06	-4.06	1.14	2.21
20.0	0.18	4.87	0.06	-4.17	1.10	2.23
21.0	0.28	4.96	0.07	-4.28	1.03	2.25
22.0	0.39	5.04	0.07	-4.40	0.95	2.26
23.0	0.52	5.13	0.07	-4.53	0.86	2.27
24.0	0.67	5.22	0.07	-4.66	0.75	2.28
25.0	0.83	5.31	0.06	-4.80	0.63	2.29
26.0	1.00	5.40	0.06	-4.94	0.49	2.30
27.0	1.18	5.49	0.05	-5.09	0.35	2.31
28.0	1.37	5.58	0.05	-5.24	0.21	2.31
29.0	1.56	5.67	0.04	-5.39	0.06	2.32
30.0	1.75	5.75	0.03	-5.53	-0.09	2.32

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
31.0	1.92	5.81	0.03	-5.65	-0.23	2.32
32.0	2.11	5.88	0.02	-5.78	-0.38	2.32
33.0	2.29	5.96	0.00	-5.91	-0.53	2.33
34.0	2.46	6.06	-0.01	-6.06	-0.66	2.34
35.0	2.62	6.14	-0.00	-6.20	-0.79	2.34
36.0	2.81	6.21	0.03	-6.35	-0.92	2.31
37.0	3.03	6.29	0.08	-6.51	-1.07	2.25
38.0	3.25	6.36	0.12	-6.68	-1.24	2.20
39.0	3.46	6.45	0.12	-6.84	-1.41	2.19
40.0	3.65	6.53	0.10	-6.98	-1.57	2.21
41.0	3.83	6.61	0.07	-7.10	-1.72	2.23
42.0	4.02	6.68	0.07	-7.23	-1.87	2.22
43.0	4.24	6.73	0.08	-7.37	-2.05	2.18
44.0	4.49	6.78	0.07	-7.51	-2.26	2.15
45.0	4.73	6.83	0.03	-7.63	-2.47	2.16
46.0	4.95	6.89	-0.03	-7.75	-2.68	2.19
47.0	5.20	6.92	-0.07	-7.86	-2.91	2.18
48.0	5.45	6.95	-0.09	-7.97	-3.14	2.15
49.0	5.70	6.98	-0.07	-8.11	-3.35	2.10
50.0	5.95	7.01	-0.05	-8.24	-3.55	2.03
51.0	6.20	7.16	-0.03	-8.48	-3.73	2.04
52.0	6.45	7.17	-0.02	-8.58	-3.95	1.97
53.0	6.55	7.12	-0.02	-8.58	-4.05	1.93
54.0	6.55	6.87	-0.02	-8.37	-4.12	1.81
55.0	6.65	6.57	-0.00	-8.17	-4.28	1.63

MACH ONE

55.245	6.70	6.51	0.00	-8.14	-4.34	1.59
56.0	6.85	6.33	0.01	-8.05	-4.51	1.45
57.0	7.15	6.18	0.01	-8.04	-4.82	1.31
58.0	7.45	6.18	-0.01	-8.16	-5.10	1.27
59.0	7.85	6.19	-0.03	-8.31	-5.46	1.20
60.0	8.18	6.19	-0.04	-8.44	-5.76	1.14
61.0	8.40	6.29	-0.05	-8.61	-5.93	1.13
62.0	8.60	6.45	-0.03	-8.83	-6.06	1.15
63.0	8.75	6.60	0.01	-9.03	-6.14	1.15
64.0	8.95	6.80	0.11	-9.31	-6.23	1.12
65.0	9.36	6.88	0.24	-9.59	-6.53	0.95

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHEMERIS ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
66.0	9.77	6.94	0.36	-9.85	-6.83	0.80
67.0	10.13	7.04	0.40	-10.08	-7.11	0.72
68.0	10.46	7.15	0.37	-10.30	-7.39	0.72
69.0	10.79	7.25	0.28	-10.48	-7.69	0.77
70.0	11.14	7.35	0.15	-10.65	-8.03	0.85
71.0	11.52	7.41	0.02	-10.81	-8.41	0.90
72.0	11.95	7.46	-0.03	-11.00	-8.80	0.87
MAXIMUM DYNAMIC PRESSURE						
73.000	12.39	7.52	-0.01	-11.23	-9.17	0.79
74.0	12.81	7.61	0.03	-11.49	-9.51	0.70
75.0	13.21	7.72	0.02	-11.74	-9.83	0.67
76.0	13.55	7.88	-0.04	-11.98	-10.13	0.71
77.0	13.85	8.05	-0.13	-12.21	-10.38	0.80
78.0	14.15	8.21	-0.17	-12.45	-10.63	0.85
79.0	14.50	8.35	-0.15	-12.71	-10.90	0.82
80.0	14.89	8.48	-0.10	-12.99	-11.20	0.75
81.0	15.31	8.58	-0.09	-13.25	-11.54	0.69
82.0	15.77	8.67	-0.10	-13.50	-11.93	0.64
83.0	16.22	8.76	-0.13	-13.74	-12.32	0.61
84.0	16.66	8.87	-0.16	-14.00	-12.70	0.59
85.0	17.08	9.00	-0.15	-14.27	-13.04	0.54
86.0	17.49	9.12	-0.12	-14.55	-13.37	0.48
87.0	17.91	9.24	-0.07	-14.83	-13.69	0.40
88.0	18.32	9.34	-0.05	-15.08	-14.03	0.34
89.0	18.75	9.44	-0.06	-15.33	-14.39	0.30
90.0	19.19	9.52	-0.06	-15.57	-14.77	0.24
91.0	19.66	9.60	-0.07	-15.82	-15.17	0.18
92.0	20.11	9.65	-0.10	-16.03	-15.57	0.12
93.0	20.57	9.71	-0.09	-16.26	-15.96	0.03
94.0	21.02	9.77	-0.05	-16.50	-16.34	-0.07
95.0	21.47	9.85	0.02	-16.77	-16.70	-0.19
96.0	21.92	9.94	0.07	-17.04	-17.06	-0.29
97.0	22.36	10.02	0.06	-17.27	-17.43	-0.35
98.0	22.83	10.09	0.03	-17.51	-17.85	-0.40
99.0	23.30	10.15	0.03	-17.74	-18.25	-0.47
100.0	23.79	10.20	0.04	-17.97	-18.68	-0.57
101.0	24.28	10.25	0.06	-18.21	-19.09	-0.68

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
102.0	24.76	10.29	0.07	-18.44	-19.51	-0.77
103.0	25.23	10.34	0.04	-18.66	-19.93	-0.84
104.0	25.70	10.40	0.01	-18.88	-20.35	-0.89
105.0	26.18	10.48	0.03	-19.14	-20.75	-0.97
106.0	26.64	10.58	0.05	-19.40	-21.14	-1.04
107.0	27.14	10.65	0.04	-19.66	-21.57	-1.12
108.0	27.68	10.70	0.05	-19.91	-22.03	-1.22
109.0	28.20	10.75	0.07	-20.17	-22.49	-1.33
110.0	28.74	10.81	0.10	-20.43	-22.94	-1.45
111.0	29.29	10.85	0.11	-20.68	-23.42	-1.57
112.0	29.84	10.87	0.09	-20.90	-23.92	-1.67
113.0	30.39	10.91	0.06	-21.14	-24.41	-1.75
114.0	30.96	10.98	0.06	-21.43	-24.91	-1.85
115.0	31.51	11.11	0.09	-21.76	-25.35	-1.94
116.0	32.05	11.23	0.10	-22.08	-25.81	-2.01
117.0	32.62	11.34	0.11	-22.39	-26.29	-2.09
118.0	33.23	11.41	0.11	-22.68	-26.81	-2.19
119.0	33.83	11.48	0.08	-22.97	-27.35	-2.27
120.0	34.45	11.54	0.04	-23.24	-27.90	-2.36
121.0	35.11	11.58	0.03	-23.53	-28.49	-2.48
122.0	35.79	11.64	0.07	-23.86	-29.07	-2.63
123.0	36.47	11.72	0.11	-24.20	-29.64	-2.79
124.0	37.14	11.81	0.17	-24.56	-30.20	-2.94
125.0	37.81	11.91	0.19	-24.91	-30.76	-3.07
126.0	38.51	11.96	0.17	-25.22	-31.39	-3.19
127.0	39.27	12.00	0.13	-25.53	-32.08	-3.31
128.0	40.09	12.02	0.12	-25.86	-32.81	-3.48
129.0	40.90	12.07	0.09	-26.20	-33.53	-3.61
130.0	41.72	12.12	0.07	-26.56	-34.26	-3.75
131.0	42.59	12.16	0.08	-26.93	-35.03	-3.94
132.0	43.49	12.18	0.10	-27.31	-35.82	-4.16
133.0	44.43	12.18	0.12	-27.68	-36.65	-4.39
134.0	45.36	12.21	0.14	-28.07	-37.48	-4.60
135.0	46.30	12.27	0.18	-28.50	-38.29	-4.82
136.0	47.23	12.33	0.18	-28.91	-39.11	-5.01
137.0	48.17	12.49	0.19	-29.41	-39.91	-5.15
138.0	49.11	12.75	0.19	-29.99	-40.68	-5.24
139.0	50.04	13.11	0.19	-30.66	-41.43	-5.28
140.0	50.98	13.58	0.20	-31.42	-42.15	-5.28
141.0	51.91	14.16	0.21	-32.27	-42.83	-5.22

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHEMERIS ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
INBOARD ENGINE CUTOFF						
141.540	52.41	14.52	0.21	-32.76	-43.19	-5.16
142.0	27.65	3.27	0.21	-13.50	-24.00	-4.91
143.0	27.25	3.06	0.22	-13.16	-23.69	-4.92
144.0	26.99	2.93	0.23	-12.95	-23.49	-4.93
145.0	26.87	2.87	0.24	-12.85	-23.40	-4.94
146.0	26.91	2.89	0.25	-12.88	-23.43	-4.95
147.0	27.10	2.98	0.26	-13.03	-23.58	-4.96
OUTBOARD ENGINE CUTOFF						
147.640	27.31	3.09	0.27	-13.20	-23.73	-4.96
148.0	5.74	-7.23	0.21	4.03	-7.15	-4.94
149.0	0.95	-8.73	0.21	7.19	-3.27	-4.57
150.0	0.71	-8.85	0.21	7.38	-3.09	-4.57
155.0	5.28	-6.79	0.24	3.84	-6.62	-4.65
160.0	5.47	-6.76	0.04	3.82	-6.85	-4.51
165.0	5.65	-6.34	0.05	3.40	-6.90	-4.35
170.0	5.63	-6.52	0.45	3.42	-6.77	-4.78
175.0	6.02	-7.10	0.85	3.61	-7.11	-5.48
180.0	5.81	-7.28	0.85	3.85	-6.96	-5.52
185.0	6.19	-7.25	0.66	3.76	-7.37	-5.43
190.0	5.98	-7.03	0.66	3.67	-7.11	-5.28
195.0	6.17	-7.21	0.46	3.82	-7.40	-5.24
200.0	6.35	-6.99	0.47	3.57	-7.50	-5.18
205.0	6.13	-7.17	0.47	3.82	-7.35	-5.21
210.0	6.32	-6.95	0.47	3.57	-7.45	-5.15
215.0	6.30	-6.93	0.47	3.56	-7.43	-5.14
220.0	6.28	-6.91	0.47	3.56	-7.41	-5.13
225.0	6.47	-6.89	0.48	3.48	-7.56	-5.17
230.0	6.45	-6.87	0.28	3.55	-7.61	-4.99
235.0	6.84	-6.85	0.28	3.39	-7.94	-5.07
240.0	6.42	-6.84	0.28	3.55	-7.57	-4.97
245.0	6.80	-6.82	0.09	3.46	-7.97	-4.88
250.0	6.79	-6.80	0.29	3.39	-7.87	-5.04
255.0	6.77	-6.98	0.29	3.56	-7.90	-5.12

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
260.0	6.75	-6.77	0.30	3.39	-7.83	-5.02
265.0	6.73	-6.75	0.30	3.39	-7.80	-5.01
270.0	6.91	-6.73	0.30	3.31	-7.95	-5.04
275.0	6.90	-6.92	0.30	3.48	-7.98	-5.13
280.0	7.08	-6.70	0.31	3.23	-8.08	-5.07
285.0	7.06	-6.68	0.31	3.24	-8.06	-5.06
290.0	7.04	-6.67	0.31	3.24	-8.03	-5.05
295.0	7.02	-6.65	0.12	3.32	-8.08	-4.87
300.0	7.20	-6.84	0.32	3.33	-8.21	-5.17
305.0	7.38	-6.62	0.32	3.09	-8.31	-5.12
310.0	7.36	-6.60	0.13	3.16	-8.36	-4.94
315.0	7.34	-6.79	0.33	3.26	-8.31	-5.19
320.0	7.52	-6.77	0.33	3.19	-8.46	-5.23
325.0	7.50	-6.56	0.34	3.02	-8.39	-5.12
330.0	7.68	-6.74	0.14	3.19	-8.67	-5.09
335.0	7.66	-6.73	0.34	3.12	-8.56	-5.25
340.0	7.64	-6.71	0.15	3.20	-8.61	-5.07
345.0	7.82	-6.70	0.35	3.05	-8.69	-5.28
350.0	7.79	-6.68	0.35	3.06	-8.66	-5.27
355.0	7.97	-6.67	0.36	2.98	-8.81	-5.30
360.0	7.95	-6.85	0.36	3.16	-8.83	-5.39
365.0	8.13	-6.84	0.37	3.08	-8.98	-5.43
370.0	8.31	-6.82	0.37	3.01	-9.13	-5.46
375.0	8.28	-6.81	0.38	3.02	-9.10	-5.45
380.0	8.46	-6.79	0.38	2.94	-9.25	-5.49
385.0	8.64	-6.97	0.39	3.04	-9.45	-5.62
390.0	8.61	-6.76	0.39	2.88	-9.37	-5.52
395.0	8.78	-6.74	0.40	2.80	-9.52	-5.55
400.0	8.76	-6.93	0.40	2.98	-9.54	-5.64
405.0	8.94	-6.91	0.40	2.90	-9.69	-5.68
410.0	9.11	-6.89	0.41	2.83	-9.83	-5.71
415.0	9.09	-7.08	0.41	3.01	-9.86	-5.80
420.0	9.26	-7.06	0.42	2.94	-10.00	-5.83
425.0	9.44	-7.04	0.42	2.86	-10.15	-5.87
430.0	9.61	-7.22	0.43	2.96	-10.35	-6.00
435.0	9.79	-7.20	0.44	2.89	-10.49	-6.04
440.0	9.76	-7.19	0.44	2.90	-10.46	-6.03
445.0	9.93	-7.17	0.45	2.82	-10.60	-6.06
450.0	10.11	-7.35	0.45	2.92	-10.80	-6.19
455.0	10.28	-7.33	0.46	2.85	-10.94	-6.23

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	CDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
460.0	10.25	-7.32	0.46	2.86	-10.91	-6.22
465.0	10.42	-7.30	0.47	2.79	-11.05	-6.25
470.0	10.79	-7.27	0.48	2.63	-11.38	-6.33
475.0	10.77	-7.46	0.48	2.81	-11.39	-6.42
480.0	10.94	-7.65	0.51	2.91	-11.58	-6.57
485.0	11.11	-7.62	0.52	2.83	-11.72	-6.61
490.0	11.48	-7.59	0.52	2.68	-12.04	-6.68
495.0	11.45	-7.78	0.52	2.86	-12.06	-6.76
500.0	11.83	-7.95	0.53	2.88	-12.43	-6.94
505.0	11.99	-7.92	0.54	2.81	-12.57	-6.97
510.0	12.16	-7.90	0.54	2.74	-12.71	-7.00
515.0	12.33	-7.87	0.55	2.67	-12.85	-7.03
520.0	12.51	-8.25	0.55	2.93	-13.09	-7.25
525.0	12.87	-8.22	0.56	2.78	-13.40	-7.33
530.0	13.04	-8.19	0.57	2.71	-13.54	-7.36
535.0	13.21	-8.36	0.57	2.80	-13.73	-7.48
540.0	13.37	-8.34	0.58	2.73	-13.87	-7.52
545.0	13.74	-8.50	0.59	2.74	-14.23	-7.69
550.0	13.91	-8.47	0.60	2.67	-14.37	-7.72
555.0	14.28	-8.83	0.61	2.85	-14.78	-7.98
560.0	14.44	-8.80	0.62	2.78	-14.91	-8.01
565.0	14.80	-8.77	0.63	2.63	-15.22	-8.09
570.0	15.17	-8.93	0.64	2.64	-15.58	-8.26
575.0	15.34	-9.09	0.65	2.74	-15.77	-8.38
580.0	15.70	-9.25	0.66	2.75	-16.13	-8.55
585.0	15.27	-9.41	0.67	2.69	-16.66	-8.76
590.0	16.63	-9.56	0.69	2.70	-17.02	-8.93
595.0	15.99	-9.52	0.70	2.55	-17.33	-9.00
600.0	17.16	-9.89	0.70	2.81	-17.56	-9.22
605.0	17.53	-10.04	0.71	2.83	-17.92	-9.38
610.0	18.09	-10.19	0.72	2.76	-18.45	-9.59
615.0	19.66	-10.53	0.74	2.86	-19.04	-9.90
620.0	19.04	-10.69	0.77	2.86	-19.40	-10.09

S-IV STAGE GUIDANCE CUTOFF

621.375	19.35	-10.67	0.78	2.73	-19.67	-10.16
625.0	-2.72	-7.88	0.34	8.57	0.72	-3.43
630.0	-2.76	-7.86	0.33	8.58	0.77	-3.41

TABLE XII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE M/S SQ	DDYE M/S SQ	DDZE M/S SQ	DDXSP M/S SQ	DDYSP M/S SQ	DDZSP M/S SQ
INSERTION						
631.375	-2.77	-7.86	0.33	8.58	0.78	-3.41

TABLE XIII
GEØGRAPHIC CØORDINATES

TIME SEC	EC DIST KM	LØNG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF	VEL M/S
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FIRST MOTION

0.060	6373.350	-80.56495	28.37067	28.53185	0.	90.000	0.
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LIFTOFF SIGNAL

0.260	6373.350	-80.56495	28.37067	28.53185	49.052	89.158	0.6
1.0	6373.351	-80.56495	28.37067	28.53185	39.772	89.459	2.8
2.0	6373.356	-80.56495	28.37067	28.53185	12.700	89.694	5.9
3.0	6373.363	-80.56495	28.37067	28.53185	333.155	89.734	9.2
4.0	6373.374	-80.56495	28.37067	28.53185	311.152	89.671	12.6
5.0	6373.389	-80.56495	28.37067	28.53185	303.383	89.597	16.1
6.0	6373.406	-80.56495	28.37067	28.53185	301.197	89.527	19.7
7.0	6373.428	-80.56495	28.37068	28.53185	301.028	89.462	23.4
8.0	6373.453	-80.56496	28.37068	28.53186	301.376	89.398	27.2
9.0	6373.482	-80.56496	28.37068	28.53186	301.580	89.335	31.0
10.0	6373.515	-80.56496	28.37068	28.53186	301.389	89.272	34.9
11.0	6373.552	-80.56497	28.37068	28.53186	300.764	89.212	38.9
12.0	6373.593	-80.56497	28.37069	28.53186	299.763	89.158	43.1
13.0	6373.638	-80.56498	28.37069	28.53187	298.475	89.112	47.3
14.0	6373.687	-80.56499	28.37069	28.53187	296.988	89.080	51.5
15.0	6373.741	-80.56499	28.37070	28.53187	295.369	89.066	55.9
16.0	6373.799	-80.56500	28.37070	28.53188	293.658	89.073	60.4
17.0	6373.862	-80.56501	28.37070	28.53188	291.854	89.108	65.0
18.0	6373.929	-80.56502	28.37071	28.53189	289.903	89.174	69.6
19.0	6374.001	-80.56503	28.37071	28.53189	287.643	89.277	74.4
20.0	6374.078	-80.56504	28.37071	28.53189	284.625	89.419	79.2
21.0	6374.159	-80.56505	28.37071	28.53189	279.268	89.604	84.1
22.0	6374.246	-80.56506	28.37072	28.53189	260.504	89.824	89.1
23.0	6374.338	-80.56506	28.37071	28.53189	144.683	89.839	94.2
24.0	6374.434	-80.56505	28.37071	28.53189	120.694	89.524	99.4
25.0	6374.536	-80.56504	28.37071	28.53189	115.107	89.143	104.6
26.0	6374.644	-80.56503	28.37070	28.53188	112.458	88.712	110.0
27.0	6374.756	-80.56500	28.37069	28.53187	110.829	88.234	115.5
28.0	6374.875	-80.56496	28.37068	28.53186	109.693	87.713	121.1
29.0	6374.998	-80.56491	28.37066	28.53184	108.844	87.155	126.7
30.0	6375.128	-80.56484	28.37064	28.53182	108.200	86.571	132.5

TABLE XIII
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST KM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL M/S
31.0	6375.263	-80.56476	28.37062	28.53180	107.694	85.967	138.4
32.0	6375.404	-80.56466	28.37059	28.53177	107.253	85.335	144.4
33.0	6375.551	-80.56453	28.37056	28.53173	106.865	84.688	150.5
34.0	6375.704	-80.56439	28.37052	28.53169	106.524	84.033	156.7
35.0	6375.862	-80.56422	28.37047	28.53165	106.254	83.370	163.0
36.0	6376.027	-80.56402	28.37042	28.53160	106.090	82.699	169.5
37.0	6376.199	-80.56380	28.37037	28.53154	106.054	82.015	176.1
38.0	6376.376	-80.56355	28.37030	28.53148	106.098	81.320	182.8
39.0	6376.560	-80.56326	28.37023	28.53140	106.154	80.611	189.7
40.0	6376.751	-80.56294	28.37015	28.53132	106.183	79.900	196.7
41.0	6376.947	-80.56259	28.37005	28.53123	106.174	79.190	203.8
42.0	6377.151	-80.56220	28.36996	28.53113	106.145	78.482	211.1
43.0	6377.361	-80.56177	28.36984	28.53102	106.112	77.772	218.5
44.0	6377.578	-80.56129	28.36972	28.53090	106.071	77.054	226.0
45.0	6377.802	-80.56078	28.36959	28.53077	106.010	76.331	233.7
46.0	6378.032	-80.56021	28.36945	28.53063	105.913	75.601	241.6
47.0	6378.270	-80.55960	28.36930	28.53047	105.788	74.869	249.5
48.0	6378.514	-80.55894	28.36913	28.53031	105.650	74.135	257.7
49.0	6378.766	-80.55822	28.36896	28.53013	105.528	73.401	266.0
50.0	6379.024	-80.55745	28.36877	28.52994	105.435	72.666	274.4
51.0	6379.290	-80.55662	28.36857	28.52974	105.369	71.932	283.0
52.0	6379.562	-80.55573	28.36835	28.52952	105.317	71.208	291.7
53.0	6379.842	-80.55477	28.36812	28.52929	105.274	70.500	300.6
54.0	6380.129	-80.55375	28.36788	28.52904	105.238	69.806	309.4
55.0	6380.423	-80.55267	28.36762	28.52878	105.214	69.122	318.1

MACH ONE

55.245	6380.495	-80.55240	28.36755	28.52872	105.209	68.954	320.3
56.0	6380.724	-80.55153	28.36734	28.52851	105.196	68.434	326.8
57.0	6381.031	-80.55031	28.36705	28.52821	105.182	67.732	335.5
58.0	6381.345	-80.54903	28.36674	28.52791	105.164	67.012	344.2
59.0	6381.665	-80.54767	28.36642	28.52758	105.143	66.274	352.9
60.0	6381.991	-80.54623	28.36608	28.52724	105.116	65.532	361.9
61.0	6382.324	-80.54472	28.36572	28.52688	105.087	64.798	371.2
62.0	6382.663	-80.54312	28.36534	28.52650	105.063	64.082	380.7
63.0	6383.009	-80.54144	28.36494	28.52610	105.052	63.382	390.5
64.0	6383.362	-80.53968	28.36452	28.52568	105.069	62.689	400.5
65.0	6383.721	-80.53783	28.36409	28.52524	105.116	61.993	410.8

TABLE XIII
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST KM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL M/S
66.0	6384.088	-80.53588	28.36362	28.52477	105.189	61.292	421.5
67.0	6384.461	-80.53385	28.36313	28.52428	105.276	60.587	432.4
68.0	6384.841	-80.53171	28.36262	28.52377	105.359	59.883	443.7
69.0	6385.229	-80.52947	28.36207	28.52322	105.421	59.184	455.3
70.0	6385.624	-80.52713	28.36150	28.52265	105.449	58.492	467.2
71.0	6386.026	-80.52467	28.36091	28.52205	105.443	57.803	479.5
72.0	6386.435	-80.52211	28.36028	28.52142	105.423	57.112	492.1

MAXIMUM DYNAMIC PRESSURE

73.000	6386.853	-80.51942	28.35963	28.52077	105.403	56.418	505.0
74.0	6387.277	-80.51662	28.35895	28.52009	105.383	55.725	518.3
75.0	6387.710	-80.51369	28.35824	28.51937	105.365	55.038	532.0
76.0	6388.150	-80.51063	28.35750	28.51863	105.345	54.362	546.1
77.0	6388.598	-80.50744	28.35673	28.51786	105.318	53.703	560.6
78.0	6389.054	-80.50411	28.35593	28.51705	105.281	53.064	575.5
79.0	6389.518	-80.50064	28.35510	28.51622	105.243	52.442	590.8
80.0	6389.991	-80.49703	28.35423	28.51535	105.213	51.831	606.5
81.0	6390.472	-80.49327	28.35333	28.51445	105.191	51.229	622.6
82.0	6390.962	-80.48936	28.35240	28.51351	105.169	50.633	639.1
83.0	6391.461	-80.48530	28.35143	28.51254	105.146	50.043	656.0
84.0	6391.968	-80.48108	28.35043	28.51153	105.123	49.460	673.3
85.0	6392.484	-80.47670	28.34939	28.51049	105.101	48.886	691.2
86.0	6393.010	-80.47215	28.34831	28.50940	105.081	48.322	709.4
87.0	6393.544	-80.46742	28.34719	28.50828	105.068	47.770	728.1
88.0	6394.088	-80.46252	28.34603	28.50711	105.060	47.228	747.2
89.0	6394.642	-80.45744	28.34483	28.50591	105.052	46.696	766.7
90.0	6395.205	-80.45218	28.34359	28.50467	105.046	46.173	786.7
91.0	6395.778	-80.44673	28.34231	28.50338	105.041	45.657	807.1
92.0	6396.361	-80.44108	28.34098	28.50205	105.036	45.149	827.9
93.0	6396.953	-80.43525	28.33960	28.50066	105.030	44.646	849.2
94.0	6397.555	-80.42921	28.33817	28.49923	105.024	44.150	870.9
95.0	6398.167	-80.42297	28.33670	28.49775	105.024	43.661	893.0
96.0	6398.788	-80.41651	28.33518	28.49622	105.031	43.182	915.6
97.0	6399.420	-80.40985	28.33360	28.49464	105.037	42.712	938.6
98.0	6400.062	-80.40296	28.33197	28.49301	105.042	42.250	962.1
99.0	6400.714	-80.39586	28.33029	28.49132	105.048	41.796	986.1
100.0	6401.377	-80.38852	28.32855	28.48958	105.053	41.348	1010.5
101.0	6402.050	-80.38096	28.32676	28.48778	105.060	40.905	1035.3

TABLE XIII
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST KM	LONG DEG	CC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF	VEL M/S
102.0	6402.733	-80.37316	28.32491	28.48592	105.065	40.470	1060.6	
103.0	6403.427	-80.36512	28.32301	28.48401	105.071	40.040	1086.4	
104.0	6404.131	-80.35683	28.32104	28.48204	105.078	39.618	1112.6	
105.0	6404.846	-80.34829	28.31902	28.48001	105.082	39.204	1139.3	
106.0	6405.572	-80.33950	28.31693	28.47791	105.087	38.799	1166.5	
107.0	6406.309	-80.33045	28.31479	28.47576	105.092	38.401	1194.2	
108.0	6407.056	-80.32114	28.31257	28.47354	105.098	38.009	1222.4	
109.0	6407.814	-80.31156	28.31030	28.47125	105.106	37.623	1251.1	
110.0	6408.584	-80.30171	28.30795	28.46890	105.114	37.243	1280.3	
111.0	6409.365	-80.29158	28.30554	28.46648	105.122	36.867	1310.0	
112.0	6410.156	-80.28116	28.30307	28.46400	105.130	36.496	1340.2	
113.0	6410.959	-80.27046	28.30052	28.46144	105.138	36.130	1371.0	
114.0	6411.773	-80.25946	28.29790	28.45881	105.145	35.770	1402.3	
115.0	6412.599	-80.24816	28.29520	28.45610	105.153	35.416	1434.2	
116.0	6413.436	-80.23656	28.29244	28.45333	105.161	35.069	1466.6	
117.0	6414.285	-80.22465	28.28959	28.45047	105.170	34.730	1499.7	
118.0	6415.145	-80.21243	28.28667	28.44754	105.180	34.398	1533.3	
119.0	6416.018	-80.19988	28.28368	28.44453	105.188	34.071	1567.5	
120.0	6416.902	-80.18701	28.28060	28.44144	105.194	33.747	1602.3	
121.0	6417.798	-80.17380	28.27744	28.43828	105.201	33.428	1637.8	
122.0	6418.707	-80.16026	28.27420	28.43502	105.208	33.112	1673.8	
123.0	6419.627	-80.14638	28.27087	28.43169	105.216	32.801	1710.6	
124.0	6420.560	-80.13214	28.26746	28.42826	105.226	32.494	1748.0	
125.0	6421.506	-80.11755	28.26396	28.42475	105.238	32.191	1786.1	
126.0	6422.464	-80.10259	28.26037	28.42114	105.250	31.893	1824.8	
127.0	6423.435	-80.08726	28.25669	28.41745	105.261	31.598	1864.3	
128.0	6424.418	-80.07156	28.25291	28.41366	105.271	31.305	1904.5	
129.0	6425.414	-80.05547	28.24905	28.40978	105.280	31.013	1945.5	
130.0	6426.423	-80.03899	28.24508	28.40579	105.289	30.725	1987.2	
131.0	6427.445	-80.02211	28.24101	28.40171	105.297	30.437	2029.8	
132.0	6428.480	-80.00482	28.23685	28.39753	105.306	30.152	2073.2	
133.0	6429.528	-79.99712	28.23257	28.39324	105.316	29.867	2117.4	
134.0	6430.590	-79.96899	28.22820	28.38885	105.326	29.583	2162.6	
135.0	6431.565	-79.95043	28.22372	28.38435	105.338	29.302	2208.6	
136.0	6432.752	-79.93142	28.21912	28.37974	105.349	29.024	2255.5	
137.0	6433.852	-79.91195	28.21441	28.37501	105.363	28.748	2303.5	
138.0	6434.966	-79.89203	28.20958	28.37016	105.378	28.477	2352.4	
139.0	6436.094	-79.87164	28.20463	28.36520	105.390	28.218	2402.4	
140.0	6437.237	-79.85077	28.19957	28.36011	105.405	27.968	2453.4	
141.0	6438.394	-79.82941	28.19438	28.35490	105.417	27.730	2505.6	

TABLE XIII
GEØGRAPHIC CØORDINATES

TIME SEC	EC DIST KM	LØNG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL M/S
INBOARD ENGINE CUTOFF							
141.540	6439.026	-79.81768	28.19152	28.35204	105.426	27.607	2534.3
142.0	6439.567	-79.80757	28.18906	28.34957	105.432	27.520	2553.0
143.0	6440.749	-79.78540	28.18366	28.34415	105.446	27.328	2579.1
144.0	6441.934	-79.76297	28.17820	28.33867	105.462	27.141	2604.3
145.0	6443.124	-79.74030	28.17267	28.33311	105.478	26.959	2629.5
146.0	6444.317	-79.71737	28.16706	28.32749	105.494	26.780	2655.1
147.0	6445.515	-79.69420	28.16140	28.32180	105.510	26.604	2680.8
OUTBOARD ENGINE CUTOFF							
147.640	6446.284	-79.67924	28.15773	28.31812	105.520	26.495	2697.4
148.0	6446.717	-79.67078	28.15566	28.31604	105.526	26.435	2703.4
149.0	6447.917	-79.64725	28.14988	28.31024	105.543	26.283	2700.7
150.0	6449.108	-79.62373	28.14411	28.30445	105.560	26.128	2697.6
155.0	6454.958	-79.50604	28.11513	28.27536	105.641	25.351	2697.4
160.0	6460.662	-79.38740	28.08576	28.24588	105.714	24.588	2708.3
165.0	6466.228	-79.26771	28.05596	28.21598	105.790	23.838	2721.4
170.0	6471.659	-79.14690	28.02573	28.18563	105.875	23.089	2735.5
175.0	6476.952	-79.02495	27.99498	28.15476	106.016	22.305	2750.4
180.0	6482.097	-78.90186	27.96362	28.12328	106.163	21.509	2766.0
185.0	6487.093	-78.77759	27.93166	28.09120	106.298	20.719	2782.7
190.0	6491.941	-78.65212	27.89910	28.05853	106.427	19.940	2800.2
195.0	6496.642	-78.52544	27.86596	28.02526	106.547	19.173	2818.7
200.0	6501.198	-78.39752	27.83223	27.99141	106.662	18.423	2838.0
205.0	6505.512	-78.26836	27.79793	27.95697	106.770	17.690	2858.2
210.0	6509.884	-78.13794	27.76304	27.92195	106.873	16.975	2879.3
215.0	6514.018	-78.00624	27.72758	27.88636	106.970	16.274	2901.2
220.0	6518.014	-77.87325	27.69154	27.85018	107.065	15.588	2924.0
225.0	6521.875	-77.73895	27.65493	27.81343	107.156	14.917	2947.6
230.0	6525.601	-77.60331	27.61774	27.77609	107.244	14.258	2972.1
235.0	6529.195	-77.46633	27.57996	27.73817	107.329	13.613	2997.5
240.0	6532.656	-77.32798	27.54159	27.69965	107.415	12.981	3023.5
245.0	6535.987	-77.18825	27.50262	27.66053	107.496	12.368	3050.5
250.0	6539.189	-77.04713	27.46305	27.62081	107.580	11.769	3078.2
255.0	6542.265	-76.90458	27.42287	27.58048	107.661	11.186	3106.4

TABLE XIII
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST KM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL M/S
260.0	6545.215	-76.76062	27.38208	27.53953	107.742	10.620	3135.5
265.0	6548.043	-76.61521	27.34066	27.49795	107.823	10.069	3165.3
270.0	6550.749	-76.46835	27.29861	27.45574	107.903	9.534	3195.8
275.0	6553.336	-76.32002	27.25592	27.41288	107.985	9.012	3227.0
280.0	6555.805	-76.17020	27.21257	27.36936	108.066	8.511	3258.9
285.0	6558.159	-76.01889	27.16856	27.32518	108.147	8.023	3291.4
290.0	6560.399	-75.86606	27.12388	27.28032	108.229	7.547	3324.6
295.0	6562.526	-75.71171	27.07851	27.23478	108.312	7.088	3358.5
300.0	6564.542	-75.55580	27.03245	27.18853	108.396	6.640	3393.0
305.0	6566.450	-75.39834	26.98568	27.14158	108.480	6.212	3428.2
310.0	6568.252	-75.23931	26.93819	27.09390	108.564	5.797	3463.9
315.0	6569.948	-75.07868	26.88996	27.04549	108.650	5.393	3500.3
320.0	6571.541	-74.91644	26.84100	26.99632	108.736	5.002	3537.4
325.0	6573.033	-74.75257	26.79127	26.94640	108.823	4.625	3575.2
330.0	6574.423	-74.58706	26.74076	26.89569	108.911	4.256	3613.7
335.0	6575.715	-74.41987	26.68947	26.84420	109.000	3.902	3652.9
340.0	6576.910	-74.25099	26.63737	26.79189	109.089	3.561	3692.8
345.0	6578.009	-74.08041	26.58446	26.73876	109.179	3.232	3733.3
350.0	6579.014	-73.90809	26.53071	26.68480	109.270	2.914	3774.5
355.0	6579.927	-73.73403	26.47611	26.62998	109.362	2.608	3816.3
360.0	6580.750	-73.55819	26.42065	26.57429	109.454	2.312	3859.0
365.0	6581.485	-73.38055	26.36430	26.51771	109.546	2.029	3902.3
370.0	6582.132	-73.20110	26.30705	26.46023	109.639	1.756	3946.3
375.0	6582.695	-73.01981	26.24889	26.40184	109.734	1.498	3990.8
380.0	6583.175	-72.83666	26.18980	26.34250	109.828	1.251	4036.1
385.0	6583.576	-72.65163	26.12976	26.28221	109.924	1.014	4082.1
390.0	6583.898	-72.46469	26.06875	26.22095	110.021	0.787	4128.8
395.0	6584.143	-72.27583	26.00675	26.15870	110.117	0.571	4176.2
400.0	6584.313	-72.08501	25.94375	26.09544	110.214	0.363	4224.3
405.0	6584.411	-71.89222	25.87973	26.03116	110.311	0.169	4273.1
410.0	6584.439	-71.69742	25.81468	25.96583	110.409	-0.017	4322.8
415.0	6584.398	-71.50059	25.74856	25.89944	110.508	-0.192	4373.1
420.0	6584.292	-71.30170	25.68136	25.83196	110.607	-0.358	4424.2
425.0	6584.122	-71.10073	25.61305	25.76336	110.706	-0.516	4476.3
430.0	6583.889	-70.89763	25.54362	25.69364	110.807	-0.667	4529.2
435.0	6583.595	-70.69238	25.47305	25.62277	110.908	-0.808	4583.0
440.0	6583.243	-70.48496	25.40130	25.55072	111.009	-0.939	4637.5
445.0	6582.836	-70.27532	25.32835	25.47746	111.112	-1.061	4692.9
450.0	6582.375	-70.06344	25.25419	25.40298	111.214	-1.172	4749.1
455.0	6581.865	-69.84931	25.17879	25.32726	111.318	-1.273	4806.1

TABLE XIII
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST KM	LONG DEG	CC LAT DEG	LAT DEC	VEL-AZ DEG	VEL-ELEV DEG	EF VEL M/S
460.0	6581.307	-69.63287	25.10213	25.25027	111.420	-1.366	4863.9
465.0	6580.706	-69.41412	25.02418	25.17199	111.525	-1.447	4922.5
470.0	6580.064	-69.19301	24.94492	25.09238	111.630	-1.519	4982.1
475.0	6579.385	-68.96951	24.86432	25.01144	111.736	-1.583	5042.5
480.0	6578.671	-68.74359	24.78235	24.92911	111.842	-1.639	5104.0
485.0	6577.926	-68.51522	24.69898	24.84538	111.950	-1.686	5166.5
490.0	6577.152	-68.28436	24.61419	24.76021	112.059	-1.726	5230.0
495.0	6576.352	-68.05096	24.52793	24.67358	112.168	-1.758	5294.7
500.0	6575.528	-67.81499	24.44019	24.58545	112.277	-1.785	5360.7
505.0	6574.682	-67.57640	24.35094	24.49580	112.386	-1.804	5427.8
510.0	6573.820	-67.33516	24.26013	24.40459	112.497	-1.813	5495.8
515.0	6572.944	-67.09122	24.16774	24.31179	112.608	-1.814	5565.1
520.0	6572.058	-66.84454	24.07372	24.21735	112.720	-1.808	5635.6
525.0	6571.166	-66.59508	23.97806	24.12126	112.831	-1.793	5707.5
530.0	6570.273	-66.34280	23.88071	24.02347	112.944	-1.769	5780.5
535.0	6569.383	-66.08764	23.78164	23.92395	113.057	-1.738	5854.8
540.0	6568.500	-65.82958	23.68081	23.82267	113.170	-1.697	5930.5
545.0	6567.628	-65.56855	23.57818	23.71957	113.284	-1.648	6007.5
550.0	6566.773	-65.30452	23.47372	23.61463	113.399	-1.591	6086.0
555.0	6565.940	-65.03742	23.36738	23.50780	113.514	-1.526	6166.1
560.0	6565.132	-64.76722	23.25911	23.39903	113.630	-1.454	6247.7
565.0	6564.355	-64.49385	23.14888	23.28830	113.746	-1.373	6330.9
570.0	6563.516	-64.21726	23.03664	23.17554	113.863	-1.284	6415.9
575.0	6562.719	-63.93740	22.92235	23.06071	113.980	-1.188	6502.6
580.0	6562.069	-63.65420	22.80596	22.94377	114.098	-1.084	6591.1
585.0	6561.473	-63.36760	22.68740	22.82466	114.217	-0.973	6681.6
590.0	6561.136	-63.07756	22.56665	22.70333	114.337	-0.853	6773.9
595.0	6560.665	-62.78399	22.44364	22.57974	114.457	-0.726	6868.3
600.0	6560.266	-62.48684	22.31832	22.45383	114.577	-0.591	6964.7
605.0	6559.948	-62.18603	22.19064	22.32553	114.697	-0.448	7063.3
610.0	6559.715	-61.88151	22.06054	22.19480	114.820	-0.299	7164.3
615.0	6559.576	-61.57319	21.92796	22.06158	114.941	-0.142	7267.6
620.0	6559.537	-61.26099	21.79282	21.92579	115.065	0.022	7373.5

S-IV STAGE GUIDANCE CUTOFF

621.375	6559.545	-61.17447	21.75521	21.88800	115.099	0.068	7403.2
625.0	6559.579	-60.94599	21.65556	21.78786	115.195	0.073	7405.9
630.0	6559.626	-60.63142	21.51754	21.64916	115.327	0.075	7405.9

TABLE XIII
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST KM	LONG DEG	GC LAT DEC	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL M/S
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INSERTION

631.375	6559.639	-60.54502	21.47947	21.61090	115.363	0.075	7405.9
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TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
FIRST MOTION							
0.060	408.9	0.	90.000	0.014	0.001	0	32
LIFTOFF SIGNAL							
0.260	408.9	0.081	89.999	0.014	0.001	0	32
1.0	409.0	0.392	89.997	0.016	0.002	0	33
2.0	409.0	0.833	89.996	0.022	0.004	0	38
3.0	409.0	1.293	89.995	0.030	0.006	0	45
4.0	409.1	1.769	89.993	0.039	0.011	0	56
5.0	409.2	2.259	89.991	0.049	0.017	0	71
6.0	409.3	2.762	89.988	0.059	0.024	0	88
7.0	409.4	3.276	89.984	0.069	0.033	0	110
8.0	409.6	3.801	89.979	0.080	0.044	-0	135
9.0	409.8	4.338	89.974	0.091	0.057	-0	164
10.0	410.1	4.886	89.968	0.102	0.072	-0	197
11.0	410.3	5.446	89.962	0.114	0.090	-1	234
12.0	410.7	6.017	89.956	0.125	0.109	-2	275
13.0	411.0	6.601	89.951	0.137	0.129	-2	320
14.0	411.5	7.195	89.947	0.149	0.153	-3	369
15.0	411.9	7.802	89.945	0.162	0.178	-4	423
16.0	412.5	8.418	89.945	0.175	0.206	-5	481
17.0	413.2	9.045	89.947	0.188	0.237	-6	544
18.0	413.9	9.682	89.952	0.202	0.270	-7	611
19.0	414.8	10.326	89.960	0.216	0.306	-8	683
20.0	415.8	10.978	89.972	0.230	0.345	-9	760
21.0	417.0	11.636	89.987	0.244	0.386	-10	841
22.0	418.3	12.298	90.006	0.259	0.430	-10	928
23.0	419.8	12.964	90.030	0.274	0.477	-10	1020
24.0	421.6	13.632	90.059	0.290	0.526	-10	1116
25.0	423.6	14.301	90.093	0.305	0.578	-9	1218
26.0	425.8	14.970	90.132	0.321	0.632	-7	1326
27.0	428.2	15.637	90.176	0.338	0.689	-4	1438
28.0	430.9	16.302	90.226	0.354	0.748	-0	1557
29.0	433.9	16.962	90.281	0.372	0.810	4	1680
30.0	437.1	17.617	90.340	0.389	0.875	11	1810

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
31.0	440.5	18.264	90.405	0.407	0.941	20	1945
32.0	444.2	18.901	90.475	0.425	1.010	30	2086
33.0	448.2	19.530	90.548	0.443	1.081	43	2233
34.0	452.4	20.150	90.625	0.463	1.156	58	2385
35.0	456.9	20.762	90.707	0.482	1.233	75	2544
36.0	461.6	21.362	90.796	0.503	1.316	95	2709
37.0	466.5	21.951	90.896	0.522	1.387	118	2881
38.0	471.7	22.526	91.006	0.541	1.456	144	3058
39.0	477.2	23.089	91.124	0.561	1.532	173	3242
40.0	482.9	23.637	91.245	0.583	1.620	205	3432
41.0	488.9	24.173	91.368	0.606	1.708	241	3629
42.0	495.1	24.694	91.493	0.629	1.796	281	3833
43.0	501.6	25.198	91.622	0.653	1.885	325	4043
44.0	508.3	25.683	91.754	0.676	1.972	373	4260
45.0	515.3	26.150	91.887	0.700	2.056	426	4484
46.0	522.6	26.597	92.020	0.724	2.139	483	4714
47.0	530.2	27.025	92.151	0.749	2.224	545	4951
48.0	538.0	27.434	92.281	0.777	2.319	613	5196
49.0	546.1	27.825	92.414	0.804	2.409	686	5447
50.0	554.4	28.197	92.552	0.834	2.507	764	5706
51.0	563.0	28.550	92.696	0.863	2.598	349	5971
52.0	571.7	28.886	92.843	0.891	2.673	939	6244
53.0	580.6	29.205	92.989	0.925	2.777	1036	6524
54.0	589.6	29.501	93.135	0.959	2.881	1139	6810
55.0	598.7	29.771	93.282	0.992	2.967	1249	7104

MACH ONE

55.245	600.9	29.832	93.319	1.000	2.984	1277	7177
56.0	607.8	30.008	93.430	1.023	3.032	1365	7405
57.0	617.0	30.212	93.580	1.055	3.095	1489	7712
58.0	626.4	30.385	93.731	1.085	3.142	1619	8026
59.0	636.0	30.533	93.883	1.116	3.182	1757	8346
60.0	645.9	30.665	94.035	1.148	3.221	1902	8672
61.0	656.1	30.790	94.186	1.182	3.265	2056	9005
62.0	666.5	30.911	94.337	1.222	3.330	2217	9344
63.0	677.2	31.029	94.491	1.264	3.396	2388	9689
64.0	688.1	31.140	94.653	1.306	3.446	2566	10042
65.0	699.4	31.240	94.826	1.346	3.480	2754	10401

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
66.0	711.0	31.327	95.010	1.390	3.519	2951	10767
67.0	723.0	31.401	95.202	1.434	3.548	3158	11141
68.0	735.3	31.465	95.395	1.483	3.582	3375	11521
69.0	747.9	31.519	95.582	1.531	3.602	3602	11908
70.0	761.0	31.565	95.757	1.585	3.637	3840	12303
71.0	774.4	31.599	95.920	1.640	3.660	4089	12705
72.0	788.2	31.619	96.077	1.698	3.677	4350	13114

MAXIMUM DYNAMIC PRESSURE

73.000	802.3	31.626	96.234	1.756	3.680	4622	13531
74.0	816.9	31.621	96.391	1.808	3.639	4907	13956
75.0	831.9	31.609	96.547	1.863	3.600	5205	14388
76.0	847.3	31.591	96.701	1.923	3.565	5515	14828
77.0	863.0	31.571	96.848	1.978	3.497	5839	15275
78.0	879.1	31.551	96.988	2.029	3.410	6177	15731
79.0	895.6	31.530	97.125	2.090	3.347	6529	16195
80.0	912.4	31.504	97.263	2.145	3.259	6895	16668
81.0	929.7	31.472	97.402	2.205	3.175	7277	17149
82.0	947.4	31.433	97.540	2.262	3.077	7673	17638
83.0	965.5	31.387	97.675	2.309	2.952	8085	18137
84.0	984.0	31.334	97.808	2.360	2.836	8513	18644
85.0	1003.0	31.276	97.939	2.401	2.699	8957	19160
86.0	1022.4	31.214	98.069	2.463	2.609	9419	19685
87.0	1042.2	31.149	98.199	2.508	2.484	9898	20219
88.0	1062.4	31.080	98.330	2.563	2.381	10394	20763
89.0	1083.1	31.008	98.459	2.611	2.267	10909	21316
90.0	1104.2	30.931	98.587	2.684	2.195	11443	21879
91.0	1125.7	30.848	98.713	2.748	2.104	11995	22451
92.0	1147.6	30.761	98.836	2.810	2.012	12567	23034
93.0	1170.0	30.668	98.957	2.867	1.913	13159	23625
94.0	1192.8	30.569	99.075	2.918	1.808	13771	24227
95.0	1216.0	30.466	99.195	2.983	1.725	14404	24838
96.0	1239.6	30.362	99.316	3.072	1.668	15058	25459
97.0	1263.7	30.254	99.435	3.153	1.597	15734	26091
98.0	1288.2	30.143	99.550	3.227	1.520	16432	26732
99.0	1313.2	30.030	99.664	3.269	1.410	17152	27384
100.0	1338.6	29.913	99.776	3.340	1.326	17896	28046
101.0	1364.5	29.792	99.886	3.413	1.245	18663	28718

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
102.0	1390.8	29.668	99.994	3.486	1.167	19454	29401
103.0	1417.6	29.541	100.100	3.561	1.091	20269	30094
104.0	1444.8	29.411	100.203	3.636	1.018	21109	30798
105.0	1472.5	29.281	100.304	3.712	0.948	21975	31512
106.0	1500.6	29.150	100.402	3.789	0.883	22867	32237
107.0	1529.2	29.018	100.499	3.865	0.827	23784	32973
108.0	1558.3	28.884	100.595	3.941	0.774	24729	33720
109.0	1587.9	28.748	100.689	4.018	0.723	25701	34478
110.0	1618.0	28.611	100.782	4.096	0.675	26700	35246
111.0	1648.6	28.472	100.874	4.174	0.630	27728	36026
112.0	1679.8	28.329	100.964	4.253	0.586	28785	36817
113.0	1711.4	28.186	101.052	4.332	0.546	29871	37619
114.0	1743.6	28.041	101.138	4.413	0.507	30986	38433
115.0	1775.4	27.897	101.222	4.494	0.471	32133	39257
116.0	1809.6	27.753	101.305	4.577	0.438	33310	40093
117.0	1843.5	27.610	101.387	4.660	0.406	34519	40941
118.0	1877.9	27.468	101.468	4.745	0.376	35759	41801
119.0	1913.0	27.326	101.546	4.832	0.349	37033	42672
120.0	1948.6	27.182	101.622	4.921	0.323	38339	43556
121.0	1984.8	27.037	101.696	5.011	0.299	39680	44451
122.0	2021.6	26.891	101.770	5.105	0.277	41054	45359
123.0	2059.2	26.745	101.843	5.202	0.256	42464	46278
124.0	2097.3	26.598	101.916	5.303	0.237	43910	47213
125.0	2136.1	26.452	101.989	5.409	0.219	45392	48155
126.0	2175.6	26.305	102.061	5.522	0.203	46910	49112
127.0	2215.8	26.157	102.131	5.654	0.189	48467	50081
128.0	2256.8	26.007	102.199	5.793	0.175	50062	51063
129.0	2293.5	25.856	102.266	5.937	0.163	51696	52058
130.0	2340.9	25.703	102.330	6.087	0.151	53370	53066
131.0	2384.2	25.549	102.394	6.244	0.139	55085	54087
132.0	2428.3	25.393	102.458	6.408	0.128	56841	55120
133.0	2473.3	25.235	102.521	6.578	0.118	58640	56167
134.0	2519.2	25.075	102.583	6.755	0.108	60482	57227
135.0	2565.9	24.914	102.646	6.940	0.099	62368	58301
136.0	2613.5	24.754	102.707	7.132	0.091	64301	59386
137.0	2662.2	24.592	102.770	7.331	0.083	66280	60485
138.0	2711.8	24.433	102.832	7.538	0.075	68305	61598
139.0	2762.4	24.280	102.891	7.753	0.068	70378	62724
140.0	2814.0	24.134	102.952	7.976	0.061	72500	63865
141.0	2866.9	23.996	103.010	8.208	0.055	74672	65021

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
INBOARD ENGINE CUTOFF							
141.540	2895.8	23.926	103.042	8.337	0.052	75866	65652
142.0	2914.8	23.873	103.064	8.429	0.049	76894	66193
143.0	2941.4	23.737	103.099	8.582	0.043	79149	67372
144.0	2967.1	23.604	103.135	8.735	0.037	81430	68556
145.0	2992.8	23.473	103.170	8.891	0.032	83737	69744
146.0	3018.9	23.345	103.206	9.050	0.027	86070	70936
147.0	3045.1	23.219	103.241	9.211	0.024	88428	72132
OUTBOARD ENGINE CUTOFF							
147.640	3062.0	23.141	103.263	9.317	0.021	89951	72900
148.0	3068.2	23.095	103.273	9.365	0.020	90812	73332
149.0	3066.0	22.958	103.288	9.431	0.017	93207	74530
150.0	3063.3	22.817	103.302	9.497	0.014	95602	75719
155.0	3065.5	22.133	103.382	9.898	0.006	107589	81560
160.0	3078.7	21.471	103.462	10.052	0.002	119680	87255
165.0	3094.0	20.823	103.546	9.872	0.001	131887	92812
170.0	3110.1	20.177	103.638	9.522	0.000	144216	98234
175.0	3127.1	19.501	103.779	9.081	0.000	156670	103516
180.0	3144.6	18.814	103.926	8.659	0.000	169255	108652
185.0	3163.3	18.133	104.062	8.054	0.000	181973	113638
190.0	3182.6	17.462	104.194	7.516	0.000	194827	118476
195.0	3202.8	16.800	104.317	6.828	0.000	207817	123167
200.0	3223.8	16.154	104.437	6.239	0.000	220945	127713
205.0	3245.5	15.522	104.551	5.806	0.000	234213	132116
210.0	3264.2	14.905	104.661	5.475	0.000	247622	136377
215.0	3291.5	14.301	104.765	5.213	0.000	261174	140500
220.0	3315.6	13.709	104.867	5.002	0.000	274870	144485
225.0	3340.5	13.129	104.967	4.828	0.000	288713	148335
230.0	3366.2	12.560	105.064	4.709	0.000	302705	152050
235.0	3392.7	12.002	105.159	4.625	0.000	316847	155631
240.0	3419.7	11.455	105.253	4.554	0.000	331142	159081
245.0	3447.7	10.924	105.345	4.517	0.000	345592	162400
250.0	3476.4	10.405	105.438	4.496	0.000	360198	165590
255.0	3505.5	9.899	105.529	4.478	0.000	374962	168653

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
260.0	3535.4	9.407	105.620	4.475	0.000	389886	171592
265.0	3566.0	8.928	105.711	4.481	0.000	404972	174407
270.0	3597.2	8.462	105.801	4.490	0.000	420221	177100
275.0	3629.0	8.007	105.893	4.502	0.000	435636	179674
280.0	3661.5	7.569	105.984	4.516	0.000	451219	182130
285.0	3694.5	7.143	106.076	4.533	0.000	466971	184470
290.0	3728.3	6.726	106.168	4.552	0.000	482894	186696
295.0	3762.6	6.323	106.260	4.573	0.000	498991	188809
300.0	3797.6	5.930	106.355	4.598	0.000	515263	190812
305.0	3833.1	5.554	106.448	4.630	0.000	531713	192706
310.0	3869.2	5.188	106.542	4.663	0.000	548343	194493
315.0	3906.0	4.832	106.638	4.698	0.000	565154	196175
320.0	3943.4	4.486	106.734	4.734	0.000	582151	197753
325.0	3981.4	4.152	106.831	4.772	0.000	599334	199230
330.0	4020.1	3.825	106.928	4.811	0.000	616707	200605
335.0	4059.5	3.510	107.027	4.853	0.000	634272	201881
340.0	4099.6	3.207	107.126	4.895	0.000	652032	203060
345.0	4140.3	2.914	107.226	4.940	0.000	669990	204143
350.0	4181.6	2.630	107.327	4.985	0.000	688149	205133
355.0	4223.6	2.356	107.428	5.033	0.000	706512	206030
360.0	4266.3	2.091	107.530	5.082	0.000	725086	206836
365.0	4309.7	1.837	107.632	5.133	0.000	743858	207554
370.0	4353.7	1.592	107.735	5.185	0.000	762849	208184
375.0	4398.4	1.359	107.840	5.238	0.000	782055	208729
380.0	4443.7	1.136	107.943	5.294	0.000	801479	209193
385.0	4489.7	0.922	108.049	5.350	0.000	821124	209575
390.0	4536.4	0.716	108.155	5.409	0.000	840994	209879
395.0	4583.8	0.520	108.262	5.469	0.000	861092	210106
400.0	4631.9	0.331	108.368	5.530	0.000	881421	210257
405.0	4680.7	0.154	108.476	5.593	0.000	901985	210337
410.0	4730.3	-0.015	108.583	5.658	0.000	922787	210345
415.0	4780.5	-0.176	108.691	5.725	0.000	943832	210285
420.0	4831.6	-0.328	108.801	5.793	0.000	965122	210159
425.0	4883.6	-0.473	108.910	5.863	0.000	986661	209969
430.0	4936.5	-0.612	109.020	5.935	0.000	1008455	209716
435.0	4990.3	-0.742	109.131	6.009	0.000	1030508	209402
440.0	5044.7	-0.863	109.243	6.084	0.000	1052823	209029
445.0	5100.0	-0.976	109.355	6.161	0.000	1075405	208600
450.0	5156.1	-1.080	109.468	6.240	0.000	1098258	208118
455.0	5213.1	-1.174	109.582	6.321	0.000	1121385	207586

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
460.0	5270.7	-1.261	109.694	6.403	0.000	1144791	207007
465.0	5329.2	-1.337	109.809	6.488	0.000	1168480	206383
470.0	5388.8	-1.404	109.924	6.574	0.000	1192457	205719
475.0	5449.1	-1.465	110.040	6.662	0.000	1216726	205016
480.0	5510.5	-1.518	110.157	6.752	0.000	1241293	204279
485.0	5572.9	-1.563	110.275	6.844	0.000	1266161	203510
490.0	5636.4	-1.601	110.394	6.937	0.000	1291338	202712
495.0	5700.9	-1.632	110.513	7.034	0.000	1316827	201887
500.0	5766.8	-1.659	110.632	7.132	0.000	1342635	201039
505.0	5833.8	-1.679	110.752	7.232	0.000	1368769	200168
510.0	5901.7	-1.688	110.872	7.335	0.000	1395234	199280
515.0	5971.0	-1.691	110.994	7.439	0.000	1422035	198378
520.0	6041.4	-1.687	111.116	7.546	0.000	1449179	197466
525.0	6113.2	-1.674	111.238	7.655	0.000	1476671	196548
530.0	6186.1	-1.653	111.361	7.765	0.000	1504519	195628
535.0	6260.3	-1.625	111.484	7.878	0.000	1532728	194710
540.0	6335.9	-1.588	111.608	7.993	0.000	1561306	193799
545.0	6412.9	-1.544	111.733	8.110	0.000	1590258	192899
550.0	6491.3	-1.492	111.858	8.229	0.000	1619593	192016
555.0	6571.4	-1.432	111.984	8.351	0.000	1649317	191153
560.0	6652.9	-1.365	112.111	8.474	0.000	1679438	190316
565.0	6736.0	-1.290	112.238	8.599	0.000	1709964	189509
570.0	6820.9	-1.208	112.365	8.727	0.000	1740903	188739
575.0	6907.6	-1.119	112.494	8.857	0.000	1772264	188011
580.0	6996.0	-1.021	112.623	8.988	0.000	1804054	187331
585.0	7086.5	-0.917	112.753	9.122	0.000	1836283	186703
590.0	7178.7	-0.805	112.883	9.258	0.000	1868961	186133
595.0	7273.0	-0.686	113.014	9.396	0.000	1902095	185630
600.0	7369.5	-0.559	113.146	9.535	0.000	1935696	185198
605.0	7468.0	-0.424	113.277	9.676	0.000	1969774	184846
610.0	7568.9	-0.283	113.411	9.819	0.000	2004338	184580
615.0	7672.2	-0.135	113.544	9.964	0.000	2039401	184406
620.0	7778.1	0.021	113.678	10.111	0.000	2074973	184332

S-IV STAGE GUIDANCE CUTOFF

621.375	7807.8	0.065	113.716	10.152	0.000	2084844	184331
625.0	7810.5	0.070	113.806	10.155	0.000	2110936	184338
630.0	7810.4	0.071	113.930	10.155	0.000	2146924	184350

TABLE XIV
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL M/S	FLT-PATH DEC	HEAD DEG	MACH	DYN-PRES N/CM SQ	RANGE M	ALTITUDE M
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INSERTION

631.375	7810.4	0.071	113.964	10.155	0.000	2156821	184354
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TABLE XV BOOSTER FREEFLIGHT TRAJECTORY

Time (sec)	X _E (ft)	Y _E (ft)	Z _E (ft)	Earth-Fixed Position DYE (ft/s)	Earth-Fixed Velocity DYE (ft/s)	Altitude (ft)	Range (nm)
160	396631	281847	1345	7927	3438	36	285554
180	554905	344587	2149	7904	2838	46	351824
200	712723	395308	3202	7877	2238	59	407218
220	870016	434065	4505	7851	1640	72	451775
240	1026722	460909	6047	7822	1047	82	485535
260	1182792	475879	7818	7785	453	95	508530
280	1338159	479009	9806	7747	-138	105	520791
300	1492766	470315	12008	7710	-731	115	522316
320	1646558	449803	14403	7667	-1322	125	513114
340	1799472	417464	16988	7621	-1923	134	493173
360	1951447	373281	19754	7575	-2507	141	462477
380	2102421	317224	22684	7523	-3100	151	420994
400	2252329	249255	25768	7467	-3698	157	368688
420	2401102	169318	28996	7408	-4298	164	305512
440	2548671	77346	32352	7346	-4902	171	231401
460	2694872	-26680	35830	7267	-5499	177	146335
480	2835850	-139783	39314	6352	-5410	161	52759
500	2888907	-187795	40666	187	-384	7	12447
520	2890079	-194954	40702	-10	-341	0	5515
536.8	2889613	-200459	40696	-36	-315	0	0
						0	477.141

d

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
FIRST MOTION						
0.060	0	106	0	0.	-0.	-0.
LIFTOFF SIGNAL						
0.260	0	106	0	0.0	1.9	-0.0
1.0	0	110	0	0.0	9.2	-0.1
2.0	0	124	0	0.0	19.5	-0.1
3.0	0	149	0	-0.1	30.3	-0.0
4.0	0	184	0	-0.2	41.4	0.0
5.0	0	231	0	-0.3	52.9	0.0
6.0	-0	290	0	-0.5	64.7	0.0
7.0	-0	361	0	-0.6	76.8	0.0
8.0	-1	444	0	-0.8	89.1	-0.0
9.0	-2	539	0	-1.1	101.7	-0.1
10.0	-3	647	0	-1.3	114.6	-0.1
11.0	-5	768	0	-1.6	127.8	-0.1
12.0	-6	902	-0	-1.9	141.2	-0.1
13.0	-8	1050	-0	-2.2	155.0	-0.1
14.0	-11	1212	-0	-2.5	169.1	-0.1
15.0	-13	1388	-0	-2.8	183.5	-0.0
16.0	-16	1579	-0	-3.0	198.1	0.1
17.0	-20	1785	-0	-3.1	213.1	0.2
18.0	-23	2005	-0	-3.1	228.4	0.3
19.0	-26	2241	-0	-2.9	243.9	0.5
20.0	-29	2493	0	-2.4	259.8	0.7
21.0	-32	2761	1	-1.7	275.9	0.9
22.0	-33	3045	2	-0.6	292.3	1.2
23.0	-33	3345	3	0.9	309.0	1.4
24.0	-32	3663	4	2.8	326.0	1.6
25.0	-28	3997	6	5.3	343.3	1.8
26.0	-22	4349	8	8.3	360.8	2.0
27.0	-13	4719	10	11.9	378.7	2.2
28.0	0	5107	13	16.1	396.8	2.4
29.0	18	5513	15	20.9	415.3	2.5
30.0	41	5937	18	26.3	434.0	2.6

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
31.0	69	6381	21	32.2	452.9	2.7
32.0	104	6843	24	38.8	472.1	2.8
33.0	146	7325	26	46.0	491.5	2.8
34.0	195	7826	29	53.8	511.3	2.8
35.0	252	8348	32	62.1	531.3	2.8
36.0	318	8889	35	71.1	551.5	2.8
37.0	393	9451	38	80.7	572.0	3.0
38.0	478	10033	42	90.9	592.8	3.3
39.0	574	10637	45	102.0	613.8	3.7
40.0	681	11261	49	113.6	635.1	4.1
41.0	800	11907	54	125.9	656.7	4.4
42.0	931	12575	58	138.8	678.5	4.6
43.0	1076	13264	63	152.4	700.5	4.8
44.0	1235	13976	68	166.7	722.6	5.1
45.0	1408	14710	73	181.8	744.9	5.2
46.0	1597	15466	79	197.7	767.4	5.2
47.0	1802	16245	84	214.3	790.1	5.1
48.0	2024	17047	89	231.8	813.0	4.8
49.0	2264	17872	94	250.0	836.0	4.6
50.0	2523	18719	99	269.0	859.2	4.4
51.0	2801	19590	103	288.7	882.5	4.2
52.0	3099	20485	107	309.1	905.8	4.1
53.0	3417	21403	112	330.0	929.2	4.1
54.0	3757	22344	116	351.2	952.3	4.0
55.0	4118	23308	120	372.9	974.9	4.0

MACH 7NE

55.245	4210	23547	121	378.3	980.3	4.0
56.0	4502	24294	124	395.1	996.8	4.0
57.0	4907	25302	128	418.1	1018.2	4.0
58.0	5336	26331	132	442.0	1039.0	4.0
59.0	5790	27380	136	467.0	1059.6	4.0
60.0	6269	28451	141	493.0	1080.3	3.9
61.0	6775	29542	144	519.7	1101.3	3.7
62.0	7307	30654	148	547.1	1122.8	3.6
63.0	7868	31788	152	575.2	1144.7	3.5
64.0	8457	32944	156	604.2	1166.9	3.8
65.0	9075	34123	160	634.3	1189.3	4.4

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
66.0	9724	35324	165	665.6	1212.0	5.3
67.0	10405	36548	171	698.2	1235.0	6.5
68.0	11120	37795	178	732.0	1258.2	7.8
69.0	11868	39065	187	766.9	1281.8	8.9
70.0	12652	40359	196	802.8	1305.8	9.6
71.0	13473	41678	206	840.0	1330.0	9.8
72.0	14331	43020	216	878.5	1354.4	9.8
MAXIMUM DYNAMIC PRESSURE						
73.000	15229	44388	226	918.5	1379.0	9.8
74.0	15167	45780	236	959.8	1403.8	9.8
75.0	17148	47196	246	1002.4	1429.0	9.8
76.0	18172	48639	255	1046.3	1454.5	9.8
77.0	19240	50107	265	1091.3	1480.6	9.6
78.0	20353	51601	275	1137.2	1507.3	9.1
79.0	21513	53123	284	1184.2	1534.5	8.6
80.0	22721	54671	292	1232.5	1562.1	8.1
81.0	23978	56248	300	1282.0	1590.0	7.8
82.0	25285	57853	308	1333.0	1618.3	7.5
83.0	26643	59486	315	1385.4	1646.9	7.1
84.0	28055	61148	322	1439.4	1675.9	6.6
85.0	29521	62839	329	1494.7	1705.2	6.2
86.0	31044	64559	335	1551.4	1734.9	5.7
87.0	32624	66310	340	1609.5	1765.0	5.4
88.0	34263	68091	346	1668.9	1795.5	5.2
89.0	35962	69903	349	1729.7	1826.3	5.0
90.0	37722	71747	351	1792.0	1857.5	4.8
91.0	39546	73622	353	1855.7	1888.9	4.7
92.0	41434	75528	355	1920.9	1920.5	4.5
93.0	43388	77466	359	1987.7	1952.3	4.2
94.0	45409	79435	363	2055.9	1984.3	4.0
95.0	47499	81436	367	2125.6	2016.4	3.9
96.0	49660	83469	371	2196.8	2048.9	4.1
97.0	51893	85535	376	2269.4	2081.7	4.2
98.0	54199	87633	380	2343.6	2114.6	4.3
99.0	56580	89765	384	2419.2	2147.9	4.5
100.0	59038	91930	389	2496.5	2181.2	4.6
101.0	61573	94129	394	2575.3	2214.8	4.8

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
102.0	64189	96361	399	2655.7	2248.5	4.9
103.0	65885	98627	404	2737.7	2282.3	5.1
104.0	69664	100927	409	2821.3	2316.4	5.3
105.0	72528	103261	414	2906.4	2350.6	5.4
106.0	75478	105630	420	2993.0	2385.2	5.4
107.0	78515	108033	425	3081.3	2420.0	5.6
108.0	81641	110471	431	3171.2	2455.0	5.7
109.0	84857	112944	437	3262.9	2490.2	6.0
110.0	88167	115452	443	3356.3	2525.6	6.2
111.0	91571	117996	449	3451.4	2561.1	6.5
112.0	95070	120576	456	3548.5	2596.6	6.8
113.0	98668	123191	463	3647.3	2632.4	7.1
114.0	102366	125842	470	3747.9	2668.3	7.3
115.0	106165	128529	477	3850.3	2704.6	7.5
116.0	110067	131252	485	3954.6	2741.2	7.8
117.0	114075	134013	493	4060.8	2778.2	8.2
118.0	118189	136810	501	4168.7	2815.5	8.6
119.0	122413	139645	510	4278.7	2853.1	8.9
120.0	126748	142518	519	4390.7	2890.9	9.0
121.0	131196	145428	528	4504.9	2928.8	9.2
122.0	135759	148377	537	4621.2	2966.9	9.4
123.0	140439	151363	547	4739.7	3005.2	9.7
124.0	145239	154388	557	4860.4	3043.9	10.1
125.0	150161	157452	567	4983.3	3082.7	10.7
126.0	155207	160555	578	5108.5	3121.9	11.3
127.0	160380	163698	589	5236.2	3161.2	11.8
128.0	165681	166879	601	5366.3	3200.6	12.2
129.0	171114	170100	614	5499.2	3240.1	12.5
130.0	176681	173361	626	5634.6	3279.8	12.8
131.0	182385	176651	639	5773.0	3319.6	13.0
132.0	188228	180001	652	5914.2	3359.5	13.3
133.0	194215	183382	666	6058.4	3399.5	13.7
134.0	200347	186802	679	6205.6	3439.5	14.1
135.0	206628	190265	694	6356.0	3479.7	14.6
136.0	213065	193762	709	6509.2	3520.1	15.1
137.0	219656	197300	725	6666.0	3560.9	15.9
138.0	226406	200879	742	6825.8	3602.1	16.8
139.0	233317	204500	759	6988.4	3644.6	17.3
140.0	240393	208165	778	7154.3	3688.6	18.3
141.0	247636	211874	797	7323.5	3734.2	18.9

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
INBOARD ENGINE CUTOFF						
141.540	251617	213896	807	7415.9	3759.6	19.5
142.0	255047	215629	817	7477.3	3774.9	19.8
143.0	262574	219407	837	7567.6	3785.4	20.4
144.0	270190	223195	859	7655.4	3794.7	21.2
145.0	277893	226993	881	7743.1	3804.0	22.1
146.0	285685	230800	904	7831.8	3813.7	23.0
147.0	293565	234616	928	7920.8	3823.4	23.9
OUTBOARD ENGINE CUTOFF						
147.640	293655	237064	944	7978.1	3830.0	24.3
148.0	301534	238443	953	8000.3	3829.1	24.7
149.0	309540	242256	982	8003.9	3801.0	25.4
150.0	317549	246041	1009	8006.3	3772.0	26.1
155.0	357677	264568	1148	8062.9	3647.7	29.6
160.0	398210	282533	1302	8150.4	3538.8	31.9
165.0	439190	299960	1469	8242.2	3432.6	34.6
170.0	480634	316854	1651	8335.7	3325.6	38.7
175.0	522552	333201	1872	8432.2	3212.3	51.0
180.0	564958	348971	2161	8530.2	3095.5	64.4
185.0	607858	364154	2513	8629.9	2978.3	76.1
190.0	651256	378752	2922	8729.7	2861.2	87.2
195.0	695156	392763	3383	8830.6	2744.1	97.1
200.0	739562	406192	3892	8931.9	2627.9	106.3
205.0	784475	419043	4444	9033.6	2512.5	114.6
210.0	829900	431318	5036	9136.4	2398.0	122.3
215.0	875839	443020	5664	9239.5	2283.8	129.0
220.0	922295	454153	6325	9343.4	2170.0	135.4
225.0	969274	464718	7016	9448.4	2056.4	141.3
230.0	1016781	474715	7736	9554.3	1942.9	146.8
235.0	1064819	484145	8483	9661.4	1829.3	151.7
240.0	1113394	493006	9254	9768.8	1715.7	156.7
245.0	1162509	501302	10049	9877.6	1603.1	161.1
250.0	1212168	509034	10866	9987.0	1490.4	165.8
255.0	1262377	516203	11705	10096.6	1378.0	169.9

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZF FT	DXE FT/S	DYE FT/S	DZE FT/S
260.0	1313137	522813	12565	10207.5	1266.2	174.1
265.0	1364453	528865	13445	10319.0	1154.7	178.3
270.0	1415328	534359	14347	10431.3	1043.5	182.3
275.0	1462768	539299	15269	10544.6	932.2	186.6
280.0	1521775	543683	16212	10658.5	822.2	190.6
285.0	1575354	547517	17175	10773.1	712.1	194.7
290.0	1629510	550800	18159	10889.1	601.6	198.8
295.0	1684247	553532	19164	11005.7	491.7	203.0
300.0	1739569	555714	20191	11123.4	381.4	207.6
305.0	1795482	557348	21239	11242.0	272.4	211.9
310.0	1851989	558435	22310	11361.2	163.2	216.2
315.0	1909097	558975	23403	11481.8	53.7	220.9
320.0	1966809	558970	24520	11603.4	-55.9	225.7
325.0	2025133	558416	25661	11726.3	-165.2	230.6
330.0	2084075	557313	26827	11850.4	-275.7	235.5
335.0	2143641	555658	28017	11975.9	-385.8	240.7
340.0	2203838	553454	29234	12102.7	-495.7	245.8
345.0	2264671	550699	30476	12230.7	-606.0	251.2
350.0	2325148	547392	31746	12360.1	-716.4	256.7
355.0	2383275	543531	33042	12490.7	-827.2	262.2
360.0	2451059	539117	34368	12622.9	-938.4	267.8
365.0	2514508	534146	35721	12756.8	-1049.7	273.5
370.0	2578630	528618	37104	12891.9	-1161.3	279.2
375.0	2643429	522532	38515	13028.2	-1272.4	285.4
380.0	2703914	515890	39957	13166.2	-1383.9	291.3
385.0	2775093	508690	41429	13305.7	-1495.8	297.5
390.0	2841973	500929	42932	13446.8	-1608.1	303.9
395.0	2909563	492605	44468	13589.4	-1720.8	310.3
400.0	2977870	483716	46035	13733.7	-1834.3	316.5
405.0	3046903	474262	47634	13879.8	-1947.4	323.1
410.0	3115670	464239	49264	14027.9	-2061.3	329.4
415.0	3187182	453646	50928	14177.4	-2175.5	336.1
420.0	3258448	442479	52626	14329.2	-2290.5	342.9
425.0	3332479	430737	54357	14483.3	-2406.4	349.5
430.0	3403285	418413	56122	14639.5	-2523.4	356.5
435.0	3476877	405501	57922	14797.9	-2641.1	363.6
440.0	3551266	391999	59758	14958.2	-2759.2	370.7
445.0	3625462	377906	61630	15120.7	-2877.9	378.0
450.0	3702476	363218	63538	15285.3	-2997.0	385.4
455.0	3779318	347934	65484	15452.1	-3116.5	392.8

TABLE XVI
EARTH-FIXED PLUMBLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
460.0	3856998	332050	67465	15620.8	-3236.6	400.0
465.0	3935529	315566	69483	15791.9	-3356.7	407.6
470.0	4014922	298479	71541	15965.8	-3477.5	415.3
475.0	4095190	280787	73637	16141.7	-3599.3	423.2
480.0	4175345	262483	75775	16320.7	-3722.0	431.2
485.0	4255403	243564	77954	16502.6	-3845.6	439.6
490.0	4341376	224023	80175	16687.2	-3970.4	448.2
495.0	4425279	203855	82438	16874.9	-4096.5	456.7
500.0	4510130	183052	84744	17066.2	-4224.8	465.4
505.0	4595945	161603	87092	17260.5	-4354.4	473.8
510.0	4682739	139506	89483	17457.6	-4484.2	482.6
515.0	4770526	116754	91920	17658.5	-4615.6	491.9
520.0	4850327	93345	94402	17862.5	-4748.1	500.9
525.0	4940156	69270	96929	18070.5	-4881.9	510.0
530.0	5040035	44523	99501	18282.0	-5016.8	519.2
535.0	5131980	19099	102120	18496.9	-5152.9	528.5
540.0	5225011	-7007	104786	18716.2	-5290.2	538.0
545.0	5310147	-33804	107499	18939.5	-5428.9	547.7
550.0	5414411	-61299	110261	19166.9	-5569.0	557.4
555.0	5510823	-89499	113072	19399.0	-5710.9	567.4
560.0	5608407	-118413	115933	19635.5	-5854.6	577.5
565.0	5707185	-148050	118846	19876.6	-5999.6	587.7
570.0	5807182	-178416	121808	20123.1	-6146.7	597.8
575.0	5903425	-209523	124824	20374.7	-6296.1	608.4
580.0	6010939	-241381	127892	20631.5	-6447.1	619.1
585.0	6114751	-274002	131016	20894.4	-6600.8	630.1
590.0	6219890	-307396	134195	21162.5	-6756.4	641.2
595.0	6324384	-341574	137430	21436.7	-6914.4	652.5
600.0	6434265	-376547	140721	21717.2	-7074.8	664.0
605.0	6543565	-412329	144069	22003.9	-7237.9	675.2
610.0	6654315	-448934	147475	22297.6	-7404.1	687.3
615.0	6765551	-486376	150942	22598.3	-7573.4	699.3
620.0	6880310	-524675	154471	22906.6	-7746.2	711.7

S-IV STAGE GUIDANCE CUTOFF

621.375	6911861	-535356	155451	22993.1	-7794.3	715.2
625.0	6995138	-563788	158052	22969.9	-7889.2	719.4
630.0	7109924	-603558	161663	22925.0	-8018.3	724.9

TABLE XVI
EARTH-FIXED PLUMPLINE POSITIONS AND VELOCITIES

TIME SEC	XE FT	YE FT	ZE FT	DXE FT/S	DYE FT/S	DZE FT/S
INSERTION						
631.375	7141437	-614608	162661	22912.5	-8053.8	726.4

TABLE XVII
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
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FIRST MOTION

0.060	-2891.514	898.855	1635.232	-398.3	-1281.2	0.
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LIFTOFF SIGNAL

0.260	-2891.527	898.813	1635.232	-399.8	-1280.7	0.9
1.0	-2891.576	898.657	1635.232	-405.9	-1278.9	4.4
2.0	-2891.644	898.447	1635.233	-414.4	-1276.2	9.4
3.0	-2891.713	898.238	1635.235	-423.4	-1273.3	14.5
4.0	-2891.783	898.028	1635.238	-432.6	-1270.3	19.8
5.0	-2891.855	897.820	1635.242	-442.1	-1267.2	25.3
6.0	-2891.929	897.611	1635.247	-451.8	-1264.1	31.0
7.0	-2892.004	897.403	1635.252	-461.8	-1260.8	36.8
8.0	-2892.080	897.196	1635.259	-471.9	-1257.5	42.8
9.0	-2892.159	896.989	1635.266	-482.3	-1254.1	48.9
10.0	-2892.239	896.783	1635.275	-492.9	-1250.5	55.1
11.0	-2892.321	896.578	1635.284	-503.8	-1246.9	61.5
12.0	-2892.405	896.373	1635.295	-514.9	-1243.2	68.0
13.0	-2892.491	896.169	1635.307	-526.2	-1239.4	74.7
14.0	-2892.578	895.965	1635.320	-537.8	-1235.5	81.4
15.0	-2892.668	895.762	1635.334	-549.7	-1231.5	88.3
16.0	-2892.759	895.560	1635.349	-561.9	-1227.5	95.3
17.0	-2892.853	895.358	1635.365	-574.4	-1223.5	102.4
18.0	-2892.948	895.157	1635.382	-587.2	-1219.6	109.5
19.0	-2893.046	894.957	1635.401	-600.3	-1215.7	116.7
20.0	-2893.146	894.757	1635.421	-613.8	-1212.0	124.0
21.0	-2893.248	894.557	1635.442	-627.6	-1208.5	131.4
22.0	-2893.352	894.359	1635.464	-641.8	-1205.2	138.8
23.0	-2893.459	894.161	1635.488	-656.4	-1202.1	146.2
24.0	-2893.568	893.963	1635.512	-671.5	-1199.4	153.7
25.0	-2893.680	893.766	1635.538	-686.9	-1197.1	161.2
26.0	-2893.794	893.570	1635.565	-702.9	-1195.2	168.7
27.0	-2893.911	893.373	1635.594	-719.3	-1193.8	176.3
28.0	-2894.031	893.177	1635.623	-736.2	-1192.8	183.9
29.0	-2894.154	892.981	1635.654	-753.6	-1192.3	191.5
30.0	-2894.279	892.784	1635.686	-771.5	-1192.3	199.1

TABLE XVII
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
31.0	-2894.408	892.588	1635.720	-789.7	-1192.7	206.7
32.0	-2894.539	892.392	1635.755	-808.4	-1193.7	214.3
33.0	-2894.674	892.195	1635.790	-827.6	-1195.1	221.9
34.0	-2894.811	891.999	1635.828	-847.2	-1197.0	229.6
35.0	-2894.952	891.801	1635.866	-867.2	-1199.3	237.3
36.0	-2895.097	891.604	1635.906	-887.8	-1202.1	244.9
37.0	-2895.245	891.406	1635.947	-908.8	-1205.3	252.3
38.0	-2895.396	891.208	1635.989	-930.4	-1209.0	259.6
39.0	-2895.551	891.009	1636.032	-952.6	-1213.3	266.9
40.0	-2895.709	890.808	1636.077	-975.2	-1218.1	274.1
41.0	-2895.872	890.608	1636.122	-998.3	-1223.5	281.3
42.0	-2896.038	890.406	1636.169	-1021.7	-1229.3	288.6
43.0	-2896.208	890.203	1636.217	-1045.7	-1235.7	295.8
44.0	-2896.382	889.999	1636.267	-1070.0	-1242.7	303.0
45.0	-2896.560	889.794	1636.317	-1094.8	-1250.4	310.1
46.0	-2896.742	889.588	1636.369	-1120.0	-1258.8	317.2
47.0	-2896.929	889.380	1636.422	-1145.6	-1268.0	324.4
48.0	-2897.119	889.171	1636.476	-1171.6	-1277.8	331.5
49.0	-2897.314	888.960	1636.531	-1198.1	-1288.2	338.6
50.0	-2897.514	888.747	1636.587	-1225.0	-1299.3	345.5
51.0	-2897.718	888.533	1636.645	-1252.3	-1311.1	352.3
52.0	-2897.926	888.316	1636.703	-1280.0	-1323.3	358.9
53.0	-2898.139	888.097	1636.763	-1307.9	-1336.0	365.3
54.0	-2898.357	887.876	1636.823	-1335.7	-1349.1	371.6
55.0	-2898.579	887.653	1636.885	-1363.3	-1362.7	377.5

MACH ONE

55.245	-2898.634	887.598	1636.900	-1370.0	-1366.1	378.8
56.0	-2898.805	887.428	1636.948	-1390.5	-1376.9	382.9
57.0	-2899.036	887.200	1637.011	-1417.5	-1391.9	387.8
58.0	-2899.272	886.970	1637.075	-1444.5	-1408.0	392.4
59.0	-2899.512	886.737	1637.140	-1471.7	-1425.1	396.6
60.0	-2899.756	886.501	1637.206	-1499.4	-1443.0	400.6
61.0	-2900.005	886.262	1637.272	-1527.6	-1461.6	404.7
62.0	-2900.259	886.020	1637.339	-1556.4	-1480.7	408.9
63.0	-2900.518	885.775	1637.407	-1585.9	-1500.2	412.9
64.0	-2900.781	885.527	1637.475	-1616.2	-1520.4	416.8
65.0	-2901.050	885.275	1637.544	-1647.2	-1541.3	420.1

TABLE XVII
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
66.0	-2901.323	885.020	1637.614	-1679.0	-1563.1	423.0
67.0	-2901.603	884.761	1637.684	-1711.6	-1585.9	425.6
68.0	-2901.887	884.498	1637.754	-1745.0	-1609.6	427.9
69.0	-2902.177	884.231	1637.824	-1779.1	-1634.4	430.4
70.0	-2902.473	883.960	1637.896	-1813.7	-1660.1	433.0
71.0	-2902.774	883.685	1637.967	-1848.9	-1687.0	435.9
72.0	-2903.081	883.405	1638.039	-1884.6	-1715.2	438.8
MAXIMUM DYNAMIC PRESSURE						
73.000	-2903.395	883.121	1638.112	-1921.1	-1744.6	441.5
74.0	-2903.714	882.831	1638.185	-1958.4	-1775.2	443.9
75.0	-2904.039	882.536	1638.258	-1996.4	-1806.9	446.2
76.0	-2904.371	882.236	1638.332	-2035.2	-1839.6	448.5
77.0	-2904.709	881.931	1638.406	-2074.9	-1873.2	451.0
78.0	-2905.054	881.620	1638.480	-2115.3	-1907.6	453.6
79.0	-2905.406	881.303	1638.555	-2156.6	-1942.9	456.4
80.0	-2905.764	880.981	1638.630	-2198.7	-1979.1	459.0
81.0	-2906.130	880.652	1638.706	-2241.7	-2016.4	461.3
82.0	-2906.502	880.317	1638.782	-2285.5	-2054.8	463.5
83.0	-2906.882	879.976	1638.859	-2330.1	-2094.6	465.6
84.0	-2907.269	879.628	1638.936	-2375.6	-2135.5	467.5
85.0	-2907.664	879.273	1639.013	-2422.0	-2177.7	469.4
86.0	-2908.067	878.911	1639.090	-2469.2	-2221.0	471.0
87.0	-2908.477	878.542	1639.168	-2517.3	-2265.3	472.5
88.0	-2908.895	878.166	1639.246	-2566.4	-2310.7	473.7
89.0	-2909.322	877.781	1639.324	-2616.2	-2357.3	474.8
90.0	-2909.757	877.390	1639.403	-2667.0	-2405.1	475.7
91.0	-2910.200	876.990	1639.482	-2718.5	-2454.1	476.3
92.0	-2910.652	876.581	1639.561	-2770.7	-2504.4	476.8
93.0	-2911.112	876.165	1639.639	-2823.7	-2556.1	477.0
94.0	-2911.581	875.740	1639.718	-2877.4	-2609.0	476.9
95.0	-2912.060	875.306	1639.797	-2931.9	-2663.2	476.5
96.0	-2912.547	874.864	1639.875	-2987.4	-2718.5	475.7
97.0	-2913.043	874.412	1639.953	-3043.6	-2775.0	474.7
98.0	-2913.549	873.950	1640.031	-3100.6	-2832.9	473.5
99.0	-2914.064	873.479	1640.109	-3158.4	-2892.0	472.0
100.0	-2914.589	872.998	1640.187	-3216.9	-2952.5	470.3
101.0	-2915.123	872.508	1640.264	-3276.3	-3014.4	468.2

TABLE XVII
SPACE-FIXED EPHEMERIS POSITIONS AND VELOCITIES

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
102.0	-2915.667	872.006	1640.341	-3336.3	-3077.7	465.9
103.0	-2916.221	871.494	1640.417	-3397.1	-3142.4	463.3
104.0	-2916.785	870.972	1640.494	-3458.7	-3208.4	460.4
105.0	-2917.360	870.438	1640.569	-3521.1	-3275.7	457.3
106.0	-2917.945	869.894	1640.644	-3584.2	-3344.4	454.1
107.0	-2918.540	869.338	1640.719	-3648.2	-3414.4	450.5
108.0	-2919.146	868.770	1640.793	-3713.1	-3485.9	446.7
109.0	-2919.762	868.190	1640.866	-3778.9	-3558.9	442.4
110.0	-2920.390	867.598	1640.938	-3845.4	-3633.3	437.9
111.0	-2921.028	866.994	1641.010	-3912.8	-3709.4	433.0
112.0	-2921.678	866.377	1641.081	-3981.0	-3787.0	427.6
113.0	-2922.339	865.747	1641.151	-4049.9	-3866.2	422.0
114.0	-2923.011	865.105	1641.220	-4119.7	-3947.0	416.1
115.0	-2923.695	864.448	1641.288	-4190.6	-4029.4	409.9
116.0	-2924.391	863.778	1641.355	-4262.4	-4113.3	403.4
117.0	-2925.098	863.094	1641.421	-4335.3	-4198.7	396.7
118.0	-2925.818	862.396	1641.485	-4409.2	-4285.8	389.7
119.0	-2926.550	861.684	1641.549	-4484.1	-4374.5	382.3
120.0	-2927.294	860.956	1641.611	-4559.8	-4465.1	374.8
121.0	-2928.051	860.214	1641.672	-4636.5	-4557.6	366.8
122.0	-2928.821	859.456	1641.732	-4714.2	-4651.9	358.4
123.0	-2929.603	858.682	1641.791	-4793.0	-4748.1	349.5
124.0	-2930.399	857.893	1641.847	-4873.0	-4846.2	340.1
125.0	-2931.207	857.087	1641.903	-4954.0	-4946.2	330.3
126.0	-2932.030	856.265	1641.956	-5036.2	-5048.1	320.0
127.0	-2932.865	855.425	1642.008	-5119.5	-5152.2	309.3
128.0	-2933.715	854.569	1642.058	-5203.7	-5258.6	298.2
129.0	-2934.578	853.694	1642.106	-5289.1	-5367.3	286.6
130.0	-2935.456	852.802	1642.152	-5375.6	-5478.4	274.5
131.0	-2936.348	851.891	1642.197	-5463.3	-5592.1	261.9
132.0	-2937.255	850.961	1642.239	-5552.2	-5708.3	248.6
133.0	-2938.176	850.012	1642.278	-5642.3	-5827.1	234.5
134.0	-2939.112	849.043	1642.316	-5733.7	-5948.6	219.8
135.0	-2940.064	848.054	1642.351	-5826.5	-6072.9	204.4
136.0	-2941.031	847.043	1642.383	-5920.5	-6199.6	188.4
137.0	-2942.013	846.011	1642.412	-6015.4	-6329.4	171.6
138.0	-2943.011	844.958	1642.439	-6113.8	-6461.6	154.2
139.0	-2944.025	843.883	1642.462	-6213.4	-6596.3	137.0
140.0	-2945.056	842.785	1642.483	-6315.5	-6733.3	119.5
141.0	-2946.104	841.665	1642.501	-6420.2	-6873.0	102.3

TABLE XVII
SPACE-FIXED EPHemeris Positions and Velocities

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
INBOARD ENGINE CUTOFF						
141.540	-2946.677	841.050	1642.509	-6477.8	-6949.1	93.0
142.0	-2947.169	840.522	1642.516	-6514.6	-7000.2	86.0
143.0	-2948.245	839.363	1642.528	-6558.6	-7078.6	70.0
144.0	-2949.328	838.191	1642.538	-6600.4	-7155.0	53.8
145.0	-2950.418	837.006	1642.545	-6642.3	-7231.3	37.6
146.0	-2951.515	835.809	1642.550	-6684.9	-7308.4	21.3
147.0	-2952.618	834.599	1642.551	-6727.6	-7385.7	4.9
OUTBOARD ENGINE CUTOFF						
147.640	-2953.329	833.818	1642.551	-6755.3	-7435.5	-5.4
148.0	-2953.729	833.377	1642.551	-6763.2	-7455.7	-11.2
149.0	-2954.841	832.149	1642.547	-6740.2	-7466.7	-26.0
150.0	-2955.948	830.918	1642.541	-6715.9	-7476.8	-41.0
155.0	-2961.433	824.736	1642.476	-6629.9	-7561.9	-116.2
160.0	-2966.864	818.469	1642.350	-6568.6	-7670.9	-190.1
165.0	-2972.245	812.110	1642.163	-6511.2	-7782.9	-263.9
170.0	-2977.579	805.659	1641.915	-6454.2	-7896.0	-339.8
175.0	-2982.866	799.115	1641.600	-6396.0	-8010.2	-426.3
180.0	-2988.105	792.476	1641.212	-6335.6	-8126.2	-515.7
185.0	-2993.293	785.740	1640.751	-6275.0	-8244.3	-604.3
190.0	-2998.432	778.908	1640.218	-6214.0	-8362.7	-692.4
195.0	-3003.520	771.977	1639.612	-6152.9	-8482.4	-779.6
200.0	-3008.558	764.947	1638.935	-6092.4	-8602.4	-866.0
205.0	-3013.546	757.819	1638.187	-6032.2	-8722.9	-951.3
210.0	-3018.486	750.591	1637.369	-5972.8	-8844.3	-1035.8
215.0	-3023.376	743.263	1636.482	-5913.4	-8966.3	-1119.5
220.0	-3028.218	735.834	1635.527	-5854.3	-9088.8	-1203.0
225.0	-3033.011	728.304	1634.503	-5795.5	-9212.4	-1286.0
230.0	-3037.755	720.672	1633.410	-5736.9	-9337.0	-1369.1
235.0	-3042.452	712.937	1632.249	-5678.3	-9462.7	-1451.8
240.0	-3047.100	705.098	1631.020	-5619.7	-9588.7	-1534.8
245.0	-3051.701	697.156	1629.724	-5562.1	-9715.8	-1617.0
250.0	-3056.254	689.108	1628.359	-5504.8	-9843.4	-1699.7
255.0	-3060.760	680.956	1626.926	-5447.3	-9971.1	-1781.8

TABLE XVII
SPACE-FIXED EPHemeris Positions and Velocities

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
260.0	-3065.219	672.698	1625.426	-5390.7	-10099.8	-1864.0
265.0	-3069.632	664.334	1623.859	-5334.6	-10228.9	-1946.2
270.0	-3073.998	655.863	1622.223	-5278.6	-10358.7	-2028.2
275.0	-3078.319	647.285	1620.520	-5223.1	-10489.2	-2110.8
280.0	-3082.595	638.600	1618.750	-5168.6	-10620.0	-2192.6
285.0	-3086.825	629.807	1616.911	-5114.1	-10751.4	-2274.7
290.0	-3091.011	620.905	1615.005	-5059.8	-10883.9	-2357.4
295.0	-3095.153	611.894	1613.031	-5006.1	-11016.9	-2440.0
300.0	-3099.250	602.773	1610.989	-4952.4	-11150.7	-2523.3
305.0	-3103.304	593.542	1608.879	-4899.9	-11285.0	-2606.0
310.0	-3107.314	584.200	1606.700	-4847.5	-11420.0	-2688.9
315.0	-3111.281	574.747	1604.453	-4795.2	-11556.0	-2772.6
320.0	-3115.206	565.181	1602.136	-4743.2	-11692.8	-2856.7
325.0	-3119.088	555.502	1599.751	-4691.7	-11830.6	-2941.0
330.0	-3122.927	545.710	1597.296	-4639.7	-11969.8	-3026.1
335.0	-3126.724	535.802	1594.770	-4588.4	-12109.9	-3111.7
340.0	-3130.478	525.779	1592.174	-4537.5	-12251.2	-3197.3
345.0	-3134.191	515.639	1589.508	-4486.8	-12393.5	-3283.7
350.0	-3137.862	505.382	1586.770	-4436.4	-12536.9	-3370.5
355.0	-3141.492	495.005	1583.960	-4386.0	-12681.4	-3457.8
360.0	-3145.081	484.510	1581.078	-4335.7	-12827.5	-3545.8
365.0	-3148.628	473.894	1578.124	-4285.9	-12974.9	-3634.2
370.0	-3152.134	463.155	1575.097	-4236.1	-13123.4	-3723.1
375.0	-3155.600	452.295	1571.996	-4187.2	-13272.8	-3812.4
380.0	-3159.025	441.311	1568.822	-4138.3	-13423.7	-3902.0
385.0	-3162.410	430.202	1565.574	-4089.7	-13575.9	-3992.5
390.0	-3165.756	418.967	1562.251	-4041.2	-13729.6	-4083.6
395.0	-3169.061	407.606	1558.853	-3992.8	-13884.7	-4175.3
400.0	-3172.326	396.115	1555.379	-3944.1	-14041.4	-4267.5
405.0	-3175.552	384.496	1551.829	-3896.4	-14199.6	-4360.4
410.0	-3178.738	372.745	1548.203	-3848.5	-14359.7	-4453.8
415.0	-3181.885	360.863	1544.499	-3800.8	-14521.0	-4548.1
420.0	-3184.993	348.846	1540.717	-3753.3	-14684.5	-4643.3
425.0	-3188.062	336.695	1536.856	-3705.4	-14850.2	-4739.3
430.0	-3191.092	324.405	1532.916	-3657.5	-15017.9	-4836.7
435.0	-3194.081	311.978	1528.896	-3609.7	-15187.7	-4934.9
440.0	-3197.032	299.409	1524.794	-3562.1	-15359.2	-5033.8
445.0	-3199.944	286.699	1520.611	-3514.6	-15532.7	-5133.6
450.0	-3202.816	273.845	1516.345	-3467.5	-15708.2	-5234.2
455.0	-3205.650	260.846	1511.996	-3420.7	-15885.6	-5335.5

TABLE XVII
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
460.0	-3208.445	247.701	1507.564	-3373.7	-16064.9	-5437.3
465.0	-3211.203	234.406	1503.047	-3327.7	-16246.2	-5540.1
470.0	-3213.922	220.962	1498.446	-3282.0	-16430.1	-5643.9
475.0	-3216.604	207.365	1493.758	-3236.0	-16615.9	-5748.7
480.0	-3219.248	193.615	1488.984	-3190.2	-16804.6	-5854.8
485.0	-3221.854	179.708	1484.121	-3144.8	-16995.8	-5962.4
490.0	-3224.423	165.643	1479.170	-3099.1	-17189.8	-6071.2
495.0	-3226.954	151.417	1474.129	-3053.3	-17386.8	-6181.4
500.0	-3229.448	137.027	1468.996	-3006.8	-17587.4	-6293.5
505.0	-3231.903	122.471	1463.770	-2960.0	-17791.1	-6406.7
510.0	-3234.319	107.746	1458.451	-2914.0	-17997.2	-6521.1
515.0	-3236.628	92.850	1453.037	-2868.0	-18206.8	-6637.3
520.0	-3239.039	77.781	1447.527	-2821.9	-18419.5	-6754.7
525.0	-3241.342	62.535	1441.920	-2776.0	-18636.1	-6873.6
530.0	-3243.607	47.109	1436.214	-2730.2	-18855.9	-6993.9
535.0	-3245.835	31.501	1430.409	-2684.5	-19079.0	-7115.7
540.0	-3248.025	15.708	1424.503	-2639.2	-19306.3	-7239.2
545.0	-3250.179	-0.274	1418.495	-2594.0	-19537.4	-7364.4
550.0	-3252.294	-16.448	1412.382	-2548.9	-19772.4	-7491.4
555.0	-3254.373	-32.816	1406.165	-2503.9	-20011.9	-7620.4
560.0	-3256.415	-49.384	1399.840	-2458.7	-20255.7	-7751.3
565.0	-3258.419	-66.154	1393.407	-2413.9	-20504.0	-7884.1
570.0	-3260.387	-83.131	1386.864	-2369.0	-20757.5	-8019.0
575.0	-3262.318	-100.318	1380.209	-2323.9	-21015.9	-8156.5
580.0	-3264.212	-117.720	1373.440	-2279.1	-21279.3	-8296.2
585.0	-3266.068	-135.341	1366.554	-2234.1	-21548.6	-8438.6
590.0	-3267.888	-153.186	1359.550	-2189.2	-21823.0	-8583.4
595.0	-3269.671	-171.259	1352.427	-2144.2	-22103.3	-8730.8
600.0	-3271.416	-189.565	1345.181	-2099.1	-22389.7	-8880.9
605.0	-3273.125	-208.109	1337.810	-2053.8	-22682.4	-9033.5
610.0	-3274.796	-226.897	1330.312	-2008.4	-22981.8	-9190.0
615.0	-3276.430	-245.934	1322.684	-1962.4	-23288.1	-9349.4
620.0	-3278.026	-265.226	1314.923	-1916.1	-23601.9	-9512.6

S-IV STAGE GUIDANCE CUTOFF

621.375	-3278.459	-270.576	1312.766	-1903.4	-23689.8	-9558.2
625.0	-3279.564	-284.712	1307.049	-1803.8	-23689.4	-9601.8
630.0	-3280.990	-304.201	1299.125	-1663.0	-23676.8	-9657.9

TABLE XVII
SPACE-FIXED EPHemeris POSITIONS AND VELOCITIES

TIME SEC	XSP NM	YSP NM	ZSP NM	DXSP FT/S	DYSP FT/S	DZSP FT/S
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INSERTION

631.375	-3281.362	-309.559	1296.938	-1624.3	-23673.2	-9573.3
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TABLE XVIII
EARTH-FIXED PLUMLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
FIRST MOTION						
0.060	0.10	9.46	-0.10	-7.88	2.26	4.58
LIFTOFF SIGNAL						
0.260	0.07	9.60	-0.08	-8.00	2.33	4.64
1.0	0.00	10.06	-0.02	-8.37	2.53	4.82
2.0	-0.06	10.56	0.02	-8.79	2.74	5.04
3.0	-0.10	10.98	0.03	-9.12	2.88	5.24
4.0	-0.12	11.32	0.03	-9.41	2.98	5.41
5.0	-0.14	11.63	0.01	-9.65	3.07	5.58
6.0	-0.16	11.92	-0.01	-9.88	3.16	5.74
7.0	-0.18	12.19	-0.03	-10.09	3.24	5.89
8.0	-0.21	12.47	-0.04	-10.31	3.33	6.03
9.0	-0.24	12.75	-0.04	-10.53	3.42	6.18
10.0	-0.27	13.03	-0.04	-10.76	3.52	6.32
11.0	-0.30	13.33	-0.02	-11.00	3.63	6.45
12.0	-0.31	13.62	-0.01	-11.25	3.72	6.58
13.0	-0.32	13.92	0.02	-11.51	3.81	6.71
14.0	-0.30	14.23	0.05	-11.78	3.88	6.82
15.0	-0.25	14.53	0.08	-12.07	3.93	6.93
16.0	-0.17	14.83	0.11	-12.37	3.94	7.03
17.0	-0.05	15.12	0.14	-12.67	3.92	7.11
18.0	0.11	15.42	0.17	-13.00	3.86	7.19
19.0	0.33	15.70	0.19	-13.33	3.75	7.26
20.0	0.59	15.99	0.21	-13.69	3.60	7.32
21.0	0.91	16.27	0.22	-14.06	3.39	7.37
22.0	1.29	16.55	0.23	-14.45	3.13	7.42
23.0	1.72	16.83	0.23	-14.86	2.81	7.46
24.0	2.20	17.12	0.22	-15.29	2.46	7.49
25.0	2.72	17.41	0.21	-15.74	2.06	7.52
26.0	3.29	17.70	0.19	-16.21	1.62	7.55
27.0	3.89	18.00	0.17	-16.70	1.16	7.57
28.0	4.50	18.30	0.15	-17.19	0.68	7.59
29.0	5.12	18.60	0.13	-17.68	0.19	7.61
30.0	5.73	18.88	0.10	-18.15	-0.29	7.63

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
31.0	5.30	19.06	0.09	-18.53	-0.75	7.60
32.0	6.91	19.31	0.05	-18.97	-1.25	7.60
33.0	7.50	19.56	0.00	-19.40	-1.72	7.64
34.0	8.05	19.87	-0.03	-19.87	-2.16	7.68
35.0	8.61	20.14	-0.01	-20.33	-2.58	7.68
36.0	9.22	20.39	0.09	-20.82	-3.02	7.56
37.0	9.93	20.63	0.26	-21.36	-3.52	7.38
38.0	10.66	20.88	0.38	-21.92	-4.07	7.23
39.0	11.36	21.16	0.40	-22.44	-4.62	7.18
40.0	11.99	21.43	0.32	-22.89	-5.14	7.24
41.0	12.57	21.69	0.22	-23.30	-5.63	7.31
42.0	13.19	21.91	0.21	-23.73	-6.13	7.28
43.0	13.93	22.07	0.25	-24.17	-6.73	7.16
44.0	14.72	22.23	0.24	-24.62	-7.40	7.07
45.0	15.51	22.41	0.10	-25.04	-8.12	7.09
46.0	15.24	22.60	-0.09	-25.42	-8.80	7.18
47.0	17.06	22.70	-0.24	-25.77	-9.56	7.16
48.0	17.88	22.80	-0.29	-26.16	-10.29	7.07
49.0	18.70	22.89	-0.24	-26.59	-10.98	6.88
50.0	19.52	23.00	-0.15	-27.04	-11.64	6.68
51.0	20.34	23.50	-0.09	-27.81	-12.23	6.68
52.0	21.16	23.51	-0.07	-28.15	-12.95	6.47
53.0	21.49	23.36	-0.07	-28.15	-13.29	6.33
54.0	21.49	22.54	-0.06	-27.47	-13.50	5.93
55.0	21.82	21.56	-0.01	-26.80	-14.03	5.35

MACH 3NE

55.245	21.98	21.37	0.00	-26.70	-14.22	5.21
56.0	22.48	20.75	0.04	-26.40	-14.81	4.77
57.0	23.46	20.27	0.04	-26.38	-15.82	4.31
58.0	24.45	20.29	-0.03	-26.76	-16.72	4.16
59.0	25.76	20.30	-0.11	-27.26	-17.92	3.93
60.0	26.83	20.31	-0.15	-27.68	-18.88	3.72
61.0	27.57	20.65	-0.15	-28.26	-19.46	3.72
62.0	28.22	21.15	-0.10	-28.96	-19.89	3.77
63.0	29.70	21.65	0.05	-29.62	-20.15	3.78
64.0	29.36	22.32	0.36	-30.56	-20.44	3.68
65.0	30.71	22.56	0.79	-31.45	-21.42	3.12

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
66.0	32.04	22.78	1.16	-32.30	-22.41	2.61
67.0	33.22	23.09	1.31	-33.08	-23.34	2.37
68.0	34.30	23.45	1.22	-33.78	-24.24	2.36
69.0	35.39	23.80	0.92	-34.39	-25.24	2.54
70.0	36.54	24.11	0.49	-34.95	-26.36	2.79
71.0	37.81	24.32	0.06	-35.47	-27.60	2.97
72.0	39.20	24.48	-0.11	-36.10	-28.87	2.87
MAXIMUM DYNAMIC PRESSURE						
73.000	40.64	24.67	-0.04	-36.86	-30.08	2.58
74.0	42.04	24.96	0.08	-37.69	-31.20	2.29
75.0	43.33	25.33	0.08	-38.51	-32.27	2.18
76.0	44.45	25.84	-0.13	-39.30	-33.22	2.54
77.0	45.43	26.40	-0.42	-40.05	-34.07	2.64
78.0	46.44	26.94	-0.56	-40.85	-34.88	2.79
79.0	47.59	27.40	-0.49	-41.71	-35.77	2.68
80.0	48.86	27.81	-0.34	-42.61	-36.75	2.46
81.0	50.24	28.15	-0.28	-43.46	-37.87	2.26
82.0	51.73	28.43	-0.32	-44.28	-39.15	2.09
83.0	53.21	28.74	-0.44	-45.07	-40.44	2.00
84.0	54.64	29.11	-0.53	-45.92	-41.66	1.93
85.0	56.03	29.52	-0.49	-46.82	-42.79	1.77
86.0	57.39	29.92	-0.39	-47.73	-43.86	1.58
87.0	58.74	30.31	-0.23	-48.64	-44.91	1.31
88.0	60.10	30.66	-0.17	-49.49	-46.02	1.13
89.0	61.50	30.97	-0.19	-50.29	-47.20	0.97
90.0	62.97	31.24	-0.20	-51.10	-48.45	0.77
91.0	64.50	31.49	-0.24	-51.89	-49.77	0.58
92.0	65.99	31.67	-0.31	-52.59	-51.09	0.39
93.0	67.49	31.85	-0.29	-53.34	-52.38	0.11
94.0	68.98	32.05	-0.16	-54.14	-53.61	-0.24
95.0	70.45	32.31	0.05	-55.01	-54.78	-0.63
96.0	71.91	32.61	0.22	-55.90	-55.96	-0.96
97.0	73.36	32.88	0.19	-56.67	-57.20	-1.14
98.0	74.90	33.11	0.11	-57.44	-58.55	-1.31
99.0	76.43	33.31	0.09	-58.20	-59.88	-1.54
100.0	78.05	33.46	0.13	-58.97	-61.28	-1.87
101.0	79.64	33.63	0.20	-59.76	-62.64	-2.22

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYF FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
102.0	81.23	33.77	0.22	-60.50	-64.02	-2.53
103.0	82.78	33.92	0.15	-61.21	-65.39	-2.74
104.0	84.32	34.11	0.04	-61.93	-66.77	-2.92
105.0	85.89	34.38	0.10	-62.79	-68.09	-3.20
106.0	87.40	34.70	0.15	-63.66	-69.34	-3.43
107.0	89.06	34.93	0.14	-64.49	-70.78	-3.68
108.0	90.80	35.10	0.15	-65.32	-72.29	-4.01
109.0	92.53	35.28	0.22	-66.16	-73.78	-4.37
110.0	94.30	35.46	0.31	-67.04	-75.28	-4.77
111.0	96.08	35.59	0.36	-67.86	-76.83	-5.16
112.0	97.89	35.65	0.28	-68.58	-78.46	-5.47
113.0	99.70	35.79	0.18	-69.37	-80.09	-5.73
114.0	101.59	36.02	0.20	-70.30	-81.72	-6.07
115.0	103.38	36.44	0.31	-71.38	-83.18	-6.36
116.0	105.16	36.86	0.34	-72.43	-84.67	-6.60
117.0	107.03	37.20	0.36	-73.45	-86.24	-6.87
118.0	109.01	37.44	0.35	-74.43	-87.97	-7.20
119.0	111.99	37.67	0.26	-75.35	-89.71	-7.46
120.0	113.01	37.87	0.15	-76.26	-91.53	-7.73
121.0	115.20	37.99	0.10	-77.19	-93.47	-8.13
122.0	117.42	38.20	0.22	-78.27	-95.37	-8.64
123.0	119.65	38.45	0.36	-79.40	-97.24	-9.15
124.0	121.85	38.76	0.55	-80.58	-99.08	-9.66
125.0	124.04	39.07	0.63	-81.71	-100.93	-10.08
126.0	126.36	39.25	0.55	-82.74	-102.99	-10.45
127.0	128.85	39.35	0.44	-83.75	-105.25	-10.87
128.0	131.52	39.43	0.39	-84.83	-107.63	-11.40
129.0	134.17	39.59	0.30	-85.96	-110.01	-11.85
130.0	136.87	39.78	0.23	-87.14	-112.41	-12.32
131.0	139.72	39.89	0.26	-88.35	-114.93	-12.94
132.0	142.69	39.97	0.34	-89.59	-117.53	-13.64
133.0	145.76	39.97	0.40	-90.81	-120.26	-14.39
134.0	148.82	40.05	0.47	-92.09	-122.96	-15.10
135.0	151.89	40.27	0.58	-93.50	-125.61	-15.80
136.0	154.97	40.45	0.60	-94.85	-128.32	-16.42
137.0	158.05	40.96	0.61	-96.48	-130.94	-16.89
138.0	161.12	41.82	0.62	-98.39	-133.47	-17.19
139.0	164.18	43.01	0.64	-100.58	-135.92	-17.33
140.0	167.25	44.56	0.66	-103.08	-138.27	-17.31
141.0	170.31	46.45	0.68	-105.86	-140.53	-17.11

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
INBOARD ENGINE CUTOFF						
141.540	171.96	47.62	0.69	-107.48	-141.71	-16.94
142.0	90.73	10.72	0.69	-44.28	-78.75	-16.10
143.0	89.41	10.05	0.72	-43.19	-77.73	-16.14
144.0	88.55	9.62	0.75	-42.48	-77.08	-16.18
145.0	88.17	9.43	0.78	-42.16	-76.79	-16.21
146.0	88.29	9.48	0.81	-42.25	-76.88	-16.24
147.0	88.91	9.79	0.85	-42.76	-77.35	-16.26
OUTBOARD ENGINE CUTOFF						
147.640	89.59	10.13	0.88	-43.30	-77.86	-16.28
148.0	18.83	-23.72	0.70	13.22	-23.47	-16.21
149.0	3.11	-28.64	0.70	23.58	-10.72	-14.98
150.0	2.33	-29.04	0.70	24.23	-10.12	-15.00
155.0	17.32	-22.28	0.79	12.59	-21.71	-15.25
160.0	17.93	-22.19	0.14	12.55	-22.47	-14.80
165.0	18.53	-20.80	0.16	11.16	-22.63	-14.28
170.0	13.48	-21.39	1.47	11.21	-22.22	-15.67
175.0	19.75	-23.28	2.80	11.84	-23.32	-17.98
180.0	19.06	-23.87	2.80	12.64	-22.83	-18.11
185.0	20.32	-23.79	2.16	12.33	-24.17	-17.81
190.0	19.61	-23.07	2.16	12.03	-23.34	-17.31
195.0	20.23	-23.65	1.51	12.54	-24.27	-17.18
200.0	20.83	-22.93	1.53	11.72	-24.61	-16.98
205.0	20.13	-23.53	1.53	12.52	-24.12	-17.11
210.0	20.72	-22.80	1.54	11.70	-24.45	-16.91
215.0	20.67	-22.74	1.55	11.69	-24.38	-16.87
220.0	20.62	-22.68	1.55	11.68	-24.30	-16.84
225.0	21.22	-22.61	1.57	11.41	-24.80	-16.95
230.0	21.17	-22.55	0.92	11.65	-24.98	-16.36
235.0	22.43	-22.47	0.93	11.11	-26.07	-16.63
240.0	21.06	-22.44	0.93	11.64	-24.82	-16.30
245.0	22.32	-22.36	0.29	11.35	-26.16	-16.00
250.0	22.26	-22.31	0.96	11.11	-25.83	-16.53
255.0	22.22	-22.91	0.96	11.67	-25.92	-16.81

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
260.0	22.15	-22.20	0.97	11.12	-25.67	-16.46
265.0	22.09	-22.15	0.98	11.12	-25.59	-16.43
270.0	22.69	-22.09	0.99	10.86	-26.10	-16.55
275.0	22.64	-22.69	1.00	11.42	-26.19	-16.83
280.0	23.22	-21.98	1.01	10.61	-26.52	-16.64
285.0	23.16	-21.93	1.02	10.62	-26.44	-16.61
290.0	23.10	-21.88	1.03	10.63	-26.35	-16.57
295.0	23.04	-21.83	0.38	10.88	-26.52	-15.99
300.0	23.64	-22.43	1.05	10.93	-26.94	-16.98
305.0	24.21	-21.71	1.07	10.13	-27.27	-16.78
310.0	24.16	-21.66	0.42	10.38	-27.44	-16.20
315.0	24.09	-22.28	1.08	10.71	-27.27	-17.04
320.0	24.68	-22.22	1.10	10.46	-27.77	-17.16
325.0	24.60	-21.52	1.11	9.92	-27.51	-16.81
330.0	25.21	-22.11	0.46	10.46	-28.43	-16.59
335.0	25.13	-22.07	1.13	10.24	-28.09	-17.22
340.0	25.07	-22.03	0.48	10.50	-28.26	-16.63
345.0	25.64	-21.97	1.15	10.01	-28.50	-17.31
350.0	25.57	-21.93	1.16	10.03	-28.41	-17.28
355.0	25.15	-21.88	1.18	9.78	-28.90	-17.40
360.0	25.09	-22.49	1.19	10.36	-28.98	-17.68
365.0	25.67	-22.43	1.20	10.11	-29.47	-17.80
370.0	27.25	-22.38	1.22	9.87	-29.96	-17.92
375.0	27.17	-22.33	1.23	9.89	-29.87	-17.89
380.0	27.75	-22.28	1.25	9.65	-30.35	-18.01
385.0	28.34	-22.87	1.26	9.96	-31.01	-18.44
390.0	28.24	-22.18	1.28	9.43	-30.74	-18.10
395.0	28.82	-22.12	1.30	9.19	-31.23	-18.22
400.0	28.75	-22.73	1.30	9.77	-31.30	-18.50
405.0	29.32	-22.67	1.32	9.53	-31.78	-18.62
410.0	29.89	-22.61	1.34	9.29	-32.26	-18.74
415.0	29.82	-23.22	1.35	9.87	-32.33	-19.02
420.0	30.39	-23.16	1.37	9.63	-32.81	-19.14
425.0	30.96	-23.10	1.39	9.39	-33.29	-19.25
430.0	31.54	-23.70	1.41	9.71	-33.94	-19.68
435.0	32.11	-23.63	1.43	9.47	-34.42	-19.80
440.0	32.02	-23.59	1.44	9.50	-34.31	-19.77
445.0	32.58	-23.53	1.46	9.26	-34.78	-19.88
450.0	33.16	-24.12	1.48	9.58	-35.43	-20.31
455.0	33.72	-24.05	1.50	9.34	-35.90	-20.43

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHemeris ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
460.0	31.62	-24.01	1.51	9.37	-35.79	-20.39
465.0	34.18	-23.94	1.53	9.14	-36.26	-20.51
470.0	35.41	-23.85	1.57	8.63	-37.32	-20.78
475.0	35.33	-24.46	1.58	9.21	-37.38	-21.05
480.0	35.91	-25.08	1.68	9.53	-37.99	-21.57
485.0	36.46	-25.01	1.69	9.30	-38.46	-21.67
490.0	37.67	-24.92	1.72	8.80	-39.51	-21.92
495.0	37.58	-25.52	1.72	9.39	-39.56	-22.19
500.0	38.80	-26.08	1.74	9.44	-40.77	-22.76
505.0	39.35	-26.00	1.76	9.21	-41.23	-22.86
510.0	39.90	-25.92	1.78	8.98	-41.69	-22.96
515.0	40.44	-25.84	1.80	8.74	-42.15	-23.06
520.0	41.03	-27.07	1.81	9.61	-42.94	-23.79
525.0	42.23	-26.96	1.84	9.11	-43.98	-24.04
530.0	42.77	-26.87	1.86	8.88	-44.43	-24.14
535.0	43.33	-27.44	1.88	9.19	-45.05	-24.55
540.0	43.87	-27.35	1.91	8.96	-45.49	-24.66
545.0	45.08	-27.89	1.94	9.01	-46.69	-25.22
550.0	45.62	-27.79	1.97	8.76	-47.14	-25.32
555.0	46.85	-28.98	2.00	9.36	-48.50	-26.19
560.0	47.39	-28.89	2.03	9.13	-48.93	-26.29
565.0	48.56	-28.76	2.07	8.63	-49.95	-26.53
570.0	49.77	-29.29	2.10	8.67	-51.13	-27.09
575.0	50.31	-29.83	2.13	8.98	-51.73	-27.49
580.0	51.51	-30.36	2.16	9.03	-52.91	-28.05
585.0	53.37	-30.86	2.21	8.81	-54.67	-28.75
590.0	54.57	-31.38	2.25	8.86	-55.85	-29.31
595.0	55.74	-31.24	2.28	8.36	-56.86	-29.53
600.0	56.31	-32.44	2.29	9.23	-57.62	-30.24
605.0	57.50	-32.95	2.33	9.28	-58.79	-30.79
610.0	59.35	-33.43	2.37	9.06	-60.54	-31.48
615.0	61.22	-34.56	2.41	9.40	-62.46	-32.48
620.0	62.47	-35.06	2.54	9.38	-63.65	-33.11

S-IV STAGE GUIDANCE CUTOFF

621.375	63.47	-34.99	2.57	8.97	-64.53	-33.52
625.0	-8.91	-25.85	1.10	28.12	2.36	-11.26
630.0	-9.05	-25.80	1.09	28.13	2.53	-11.19

TABLE XVIII
EARTH-FIXED PLUMBLINE AND SPACE-FIXED EPHEMERIS ACCELERATIONS

TIME SEC	DDXE FT/S SQ	DDYE FT/S SQ	DDZE FT/S SQ	DDXSP FT/S SQ	DDYSP FT/S SQ	DDZSP FT/S SQ
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INSERTION

631.375	-7.09	-25.79	1.09	28.14	2.57	-11.17
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TABLE XIX
GEØGRAPHIC CØORDINATES

TIME SEC	EC NM	LØNG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
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FIRST MOTION

0.060	3441.334	-80.56495	28.37067	28.53185	0.	90.000	0.
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LIFTØFF SIGNAL

0.260	3441.334	-80.56495	28.37067	28.53185	49.052	89.158	1.9
1.0	3441.335	-80.56495	28.37067	28.53185	39.772	89.459	9.2
2.0	3441.337	-80.56495	28.37067	28.53185	12.700	89.694	19.5
3.0	3441.341	-80.56495	28.37067	28.53185	333.155	89.734	30.3
4.0	3441.347	-80.56495	28.37067	28.53185	311.152	89.671	41.4
5.0	3441.355	-80.56495	28.37067	28.53185	303.383	89.597	52.9
6.0	3441.364	-80.56495	28.37067	28.53185	301.197	89.527	64.7
7.0	3441.376	-80.56495	28.37068	28.53185	301.028	89.462	76.8
8.0	3441.389	-80.56496	28.37068	28.53186	301.376	89.398	89.1
9.0	3441.405	-80.56496	28.37068	28.53186	301.580	89.335	101.7
10.0	3441.423	-80.56496	28.37068	28.53186	301.389	89.272	114.6
11.0	3441.443	-80.56497	28.37068	28.53186	300.764	89.212	127.8
12.0	3441.465	-80.56497	28.37069	28.53186	299.763	89.158	141.3
13.0	3441.489	-80.56498	28.37069	28.53187	298.475	89.112	155.0
14.0	3441.516	-80.56499	28.37069	28.53187	296.988	89.080	169.1
15.0	3441.545	-80.56499	28.37070	28.53187	295.369	89.066	183.5
16.0	3441.576	-80.56500	28.37070	28.53188	293.658	89.073	198.2
17.0	3441.610	-80.56501	28.37070	28.53188	291.854	89.108	213.1
18.0	3441.646	-80.56502	28.37071	28.53189	289.903	89.174	228.4
19.0	3441.685	-80.56503	28.37071	28.53189	287.643	89.277	244.0
20.0	3441.727	-80.56504	28.37071	28.53189	284.625	89.419	259.8
21.0	3441.771	-80.56505	28.37071	28.53189	279.268	89.604	275.9
22.0	3441.818	-80.56506	28.37072	28.53189	260.504	89.824	292.3
23.0	3441.867	-80.56506	28.37071	28.53189	144.683	89.839	309.0
24.0	3441.919	-80.56505	28.37071	28.53189	120.694	89.524	326.0
25.0	3441.974	-80.56504	28.37071	28.53189	115.107	89.143	343.3
26.0	3442.032	-80.56503	28.37070	28.53188	112.458	88.712	360.9
27.0	3442.093	-80.56500	28.37069	28.53187	110.829	88.234	378.9
28.0	3442.157	-80.56496	28.37068	28.53186	109.693	87.713	397.1
29.0	3442.224	-80.56491	28.37066	28.53184	108.844	87.155	415.8
30.0	3442.294	-80.56484	28.37064	28.53182	108.200	86.571	434.8

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LØNG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
31.0	3442.367	-80.56476	28.37062	28.53180	107.694	85.967	454.1
32.0	3442.443	-80.56466	28.37059	28.53177	107.253	85.335	473.7
33.0	3442.522	-80.56453	28.37056	28.53173	106.865	84.688	493.7
34.0	3442.605	-80.56439	28.37052	28.53169	106.524	84.033	514.1
35.0	3442.690	-80.56422	28.37047	28.53165	106.254	83.370	534.9
36.0	3442.779	-80.56402	28.37042	28.53160	106.090	82.699	556.1
37.0	3442.872	-80.56380	28.37037	28.53154	106.054	82.015	577.7
38.0	3442.968	-80.56355	28.37030	28.53148	106.098	81.320	599.7
39.0	3443.067	-80.56326	28.37023	28.53140	106.154	80.611	622.3
40.0	3443.170	-80.56294	28.37015	28.53132	106.183	79.900	645.2
41.0	3443.276	-80.56259	28.37005	28.53123	106.174	79.190	668.7
42.0	3443.386	-80.56220	28.36996	28.53113	106.145	78.482	692.5
43.0	3443.500	-80.56177	28.36984	28.53102	106.112	77.772	716.9
44.0	3443.617	-80.56129	28.36972	28.53090	106.071	77.054	741.6
45.0	3443.738	-80.56078	28.36959	28.53077	106.010	76.331	766.8
46.0	3443.862	-80.56021	28.36945	28.53063	105.913	75.601	792.5
47.0	3443.990	-80.55960	28.36930	28.53047	105.788	74.869	818.7
48.0	3444.122	-80.55894	28.36913	28.53031	105.650	74.135	845.4
49.0	3444.258	-80.55822	28.36896	28.53013	105.528	73.401	872.6
50.0	3444.398	-80.55745	28.36877	28.52994	105.435	72.666	900.3
51.0	3444.541	-80.55662	28.36857	28.52974	105.369	71.932	928.5
52.0	3444.688	-80.55573	28.36835	28.52952	105.317	71.208	957.1
53.0	3444.839	-80.55477	28.36812	28.52929	105.274	70.500	986.1
54.0	3444.994	-80.55375	28.36788	28.52904	105.238	69.806	1015.0
55.0	3445.153	-80.55267	28.36762	28.52878	105.214	69.122	1043.8

MACH ONE

55.245	3445.192	-80.55240	28.36755	28.52872	105.209	68.954	1050.8
56.0	3445.315	-80.55153	28.36734	28.52851	105.196	68.434	1072.3
57.0	3445.481	-80.55031	28.36705	28.52821	105.182	67.732	1100.7
58.0	3445.651	-80.54903	28.36674	28.52791	105.164	67.012	1129.1
59.0	3445.823	-80.54767	28.36642	28.52758	105.143	66.274	1158.0
60.0	3446.000	-80.54623	28.36608	28.52724	105.116	65.532	1187.5
61.0	3446.179	-80.54472	28.36572	28.52688	105.087	64.798	1217.8
62.0	3446.363	-80.54312	28.36534	28.52650	105.063	64.082	1249.0
63.0	3446.549	-80.54144	28.36494	28.52610	105.052	63.382	1281.1
64.0	3446.740	-80.53968	28.36452	28.52568	105.069	62.689	1314.0
65.0	3446.934	-80.53783	28.36409	28.52524	105.116	61.993	1347.9

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
66.0	3447.132	-80.53588	28.36362	28.52477	105.189	61.292	1382.8
67.0	3447.333	-80.53385	28.36313	28.52428	105.276	60.587	1418.7
68.0	3447.539	-80.53171	28.36262	28.52377	105.359	59.883	1455.7
69.0	3447.748	-80.52947	28.36207	28.52322	105.421	59.184	1493.7
70.0	3447.961	-80.52713	28.36150	28.52265	105.449	58.492	1532.9
71.0	3448.178	-80.52467	28.36091	28.52205	105.443	57.803	1573.1
72.0	3448.399	-80.52211	28.36028	28.52142	105.423	57.112	1614.4

MAXIMUM DYNAMIC PRESSURE

73.000	3448.625	-80.51942	28.35963	28.52077	105.403	56.418	1656.9
74.0	3448.854	-80.51662	28.35895	28.52009	105.383	55.725	1700.6
75.0	3449.087	-80.51369	28.35824	28.51937	105.365	55.038	1745.5
76.0	3449.325	-80.51063	28.35750	28.51863	105.345	54.362	1791.8
77.0	3449.567	-80.50744	28.35673	28.51786	105.318	53.703	1839.4
78.0	3449.813	-80.50411	28.35593	28.51705	105.281	53.064	1888.2
79.0	3450.064	-80.50064	28.35510	28.51622	105.243	52.442	1938.3
80.0	3450.319	-80.49703	28.35423	28.51535	105.213	51.831	1989.7
81.0	3450.579	-80.49327	28.35333	28.51445	105.191	51.229	2042.5
82.0	3450.843	-80.48936	28.35240	28.51351	105.169	50.633	2096.7
83.0	3451.113	-80.48530	28.35143	28.51254	105.146	50.043	2152.2
84.0	3451.387	-80.48108	28.35043	28.51153	105.123	49.460	2209.2
85.0	3451.665	-80.47670	28.34939	28.51049	105.101	48.886	2267.6
86.0	3451.949	-80.47215	28.34831	28.50940	105.081	48.322	2327.4
87.0	3452.238	-80.46742	28.34719	28.50828	105.068	47.770	2388.7
88.0	3452.531	-80.46252	28.34603	28.50711	105.060	47.228	2451.3
89.0	3452.830	-80.45744	28.34483	28.50591	105.052	46.696	2515.5
90.0	3453.135	-80.45218	28.34359	28.50467	105.046	46.173	2581.0
91.0	3453.444	-80.44673	28.34231	28.50338	105.041	45.657	2648.0
92.0	3453.759	-80.44108	28.34098	28.50205	105.036	45.149	2716.3
93.0	3454.078	-80.43525	28.33960	28.50066	105.030	44.646	2786.1
94.0	3454.403	-80.42921	28.33817	28.49923	105.024	44.150	2857.3
95.0	3454.734	-80.42297	28.33670	28.49775	105.024	43.661	2929.9
96.0	3455.069	-80.41651	28.33518	28.49622	105.031	43.182	3004.0
97.0	3455.411	-80.40985	28.33360	28.49464	105.037	42.712	3079.6
98.0	3455.757	-80.40296	28.33197	28.49301	105.042	42.250	3156.6
99.0	3456.109	-80.39586	28.33029	28.49132	105.048	41.796	3235.1
100.0	3456.467	-80.38852	28.32855	28.48958	105.053	41.348	3315.1
101.0	3456.830	-80.38096	28.32676	28.48778	105.060	40.905	3396.7

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
102.0	3457.199	-80.37316	28.32491	28.48592	105.065	40.470	3479.8
103.0	3457.574	-80.36512	28.32301	28.48401	105.071	40.040	3564.3
104.0	3457.954	-80.35683	28.32104	28.48204	105.078	39.618	3650.4
105.0	3458.340	-80.34829	28.31902	28.48001	105.082	39.204	3738.0
106.0	3458.732	-80.33950	28.31693	28.47791	105.087	38.799	3827.2
107.0	3459.130	-80.33045	28.31479	28.47576	105.092	38.401	3918.0
108.0	3459.534	-80.32114	28.31257	28.47354	105.098	38.009	4010.4
109.0	3459.943	-80.31156	28.31030	28.47125	105.106	37.623	4104.6
110.0	3460.359	-80.30171	28.30795	28.46890	105.114	37.243	4200.4
111.0	3460.780	-80.29158	28.30554	28.46648	105.122	36.867	4297.9
112.0	3461.207	-80.28116	28.30307	28.46400	105.130	36.496	4397.1
113.0	3461.641	-80.27046	28.30052	28.46144	105.138	36.130	4498.0
114.0	3462.081	-80.25946	28.29790	28.45881	105.145	35.770	4600.7
115.0	3462.526	-80.24816	28.29520	28.45610	105.153	35.416	4705.3
116.0	3462.978	-80.23656	28.29244	28.45333	105.161	35.069	4811.8
117.0	3463.437	-80.22465	28.28959	28.45047	105.170	34.730	4920.2
118.0	3463.901	-80.21243	28.28667	28.44754	105.180	34.398	5030.5
119.0	3464.372	-80.19988	28.28368	28.44453	105.188	34.071	5142.7
120.0	3464.350	-80.18701	28.28060	28.44144	105.194	33.747	5257.0
121.0	3465.334	-80.17380	28.27744	28.43828	105.201	33.428	5373.2
122.0	3465.324	-80.16026	28.27420	28.43502	105.208	33.112	5491.6
123.0	3466.322	-80.14638	28.27087	28.43169	105.216	32.801	5612.1
124.0	3466.325	-80.13214	28.26746	28.42826	105.226	32.494	5734.9
125.0	3467.336	-80.11755	28.26396	28.42475	105.238	32.191	5859.8
126.0	3467.353	-80.10259	28.26037	28.42114	105.250	31.893	5987.0
127.0	3468.377	-80.08726	28.25669	28.41745	105.261	31.598	6116.4
128.0	3468.308	-80.07156	28.25291	28.41366	105.271	31.305	6248.3
129.0	3469.446	-80.05547	28.24905	28.40978	105.280	31.013	6382.7
130.0	3469.291	-80.03899	28.24508	28.40579	105.289	30.725	6519.7
131.0	3470.543	-80.02211	28.24101	28.40171	105.297	30.437	6659.4
132.0	3471.102	-80.00482	28.23685	28.39753	105.306	30.152	6801.8
133.0	3471.568	-79.98712	28.23257	28.39324	105.316	29.867	6947.0
134.0	3472.241	-79.96899	28.22820	28.38885	105.326	29.583	7095.1
135.0	3472.321	-79.95043	28.22372	28.38435	105.338	29.302	7246.2
136.0	3473.408	-79.93142	28.21912	28.37974	105.349	29.024	7400.1
137.0	3474.002	-79.91195	28.21441	28.37501	105.363	28.748	7557.5
138.0	3474.604	-79.89203	28.20958	28.37016	105.378	28.477	7717.9
139.0	3475.213	-79.87164	28.20463	28.36520	105.390	28.218	7881.7
140.0	3475.830	-79.85077	28.19957	28.36011	105.405	27.968	8049.3
141.0	3476.455	-79.82941	28.19438	28.35490	105.417	27.730	8220.6

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
INBOARD ENGINE CUTOFF							
141.540	3476.796	-79.81768	28.19152	28.35204	105.426	27.607	8314.5
142.0	3477.088	-79.80757	28.18906	28.34957	105.432	27.520	8376.1
143.0	3477.726	-79.78540	28.18366	28.34415	105.446	27.328	8461.6
144.0	3478.366	-79.76297	28.17820	28.33867	105.462	27.141	8544.3
145.0	3479.008	-79.74030	28.17267	28.33311	105.478	26.959	8627.1
146.0	3479.653	-79.71737	28.16706	28.32749	105.494	26.780	8711.0
147.0	3480.300	-79.69420	28.16140	28.32180	105.510	26.604	8795.3
OUTBOARD ENGINE CUTOFF							
147.640	3480.715	-79.67924	28.15773	28.31812	105.520	26.495	8849.8
148.0	3480.949	-79.67078	28.15566	28.31604	105.526	26.435	8869.4
149.0	3481.596	-79.64725	28.14988	28.31024	105.543	26.283	8860.7
150.0	3482.240	-79.62373	28.14411	28.30445	105.560	26.128	8850.4
155.0	3485.399	-79.50604	28.11513	28.27536	105.641	25.351	8849.7
160.0	3488.479	-79.38740	28.08576	28.24588	105.714	24.588	8885.6
165.0	3491.484	-79.26771	28.05596	28.21598	105.790	23.838	8928.5
170.0	3494.417	-79.14690	28.02573	28.18563	105.875	23.089	8974.7
175.0	3497.274	-79.02495	27.99498	28.15476	106.016	22.305	9023.5
180.0	3500.052	-78.90186	27.96362	28.12328	106.163	21.509	9074.7
185.0	3502.750	-78.77759	27.93166	28.09120	106.298	20.719	9129.7
190.0	3505.368	-78.65212	27.89910	28.05853	106.427	19.940	9187.1
195.0	3507.906	-78.52544	27.86596	28.02526	106.547	19.173	9247.7
200.0	3510.366	-78.39752	27.83223	27.99141	106.662	18.423	9311.1
205.0	3512.749	-78.26836	27.79793	27.95697	106.770	17.690	9377.2
210.0	3515.056	-78.13794	27.76304	27.92195	106.873	16.975	9446.6
215.0	3517.288	-78.00624	27.72758	27.88636	106.970	16.274	9518.5
220.0	3519.446	-77.87325	27.69154	27.85018	107.065	15.588	9593.0
225.0	3521.531	-77.73895	27.65493	27.81343	107.156	14.917	9670.6
230.0	3523.543	-77.60331	27.61774	27.77609	107.244	14.258	9751.0
235.0	3525.483	-77.46633	27.57996	27.73817	107.329	13.613	9834.2
240.0	3527.352	-77.32798	27.54159	27.69965	107.415	12.981	9919.5
245.0	3529.151	-77.18825	27.50262	27.66053	107.496	12.368	10008.1
250.0	3530.880	-77.04713	27.46305	27.62081	107.580	11.769	10059.0
255.0	3532.540	-76.90458	27.42287	27.58048	107.661	11.186	10191.6

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
260.0	3534.134	-76.76062	27.38208	27.53953	107.742	10.620	10287.2
265.0	3535.661	-76.61521	27.34066	27.49795	107.823	10.069	10385.0
270.0	3537.122	-76.46835	27.29861	27.45574	107.903	9.534	10484.9
275.0	3538.519	-76.32002	27.25592	27.41288	107.985	9.012	10587.3
280.0	3539.852	-76.17020	27.21257	27.36936	108.066	8.511	10691.9
285.0	3541.123	-76.01889	27.16856	27.32518	108.147	8.023	10798.4
290.0	3542.332	-75.86606	27.12388	27.28032	108.229	7.547	10907.5
295.0	3543.480	-75.71171	27.07851	27.23478	108.312	7.088	11018.6
300.0	3544.569	-75.55580	27.03245	27.18853	108.396	6.640	11131.8
305.0	3545.599	-75.39834	26.98568	27.14158	108.480	6.212	11247.3
310.0	3546.572	-75.23931	26.93819	27.09390	108.564	5.797	11364.5
315.0	3547.488	-75.07868	26.88996	27.04549	108.650	5.393	11484.1
320.0	3548.349	-74.91644	26.84100	26.99632	108.736	5.002	11605.7
325.0	3549.154	-74.75257	26.79127	26.94640	108.823	4.625	11729.7
330.0	3549.905	-74.58706	26.74076	26.89569	108.911	4.256	11856.0
335.0	3550.602	-74.41987	26.68947	26.84420	109.000	3.902	11984.6
340.0	3551.247	-74.25099	26.63737	26.79189	109.089	3.561	12115.3
345.0	3551.841	-74.08041	26.58446	26.73876	109.179	3.232	12248.3
350.0	3552.383	-73.90809	26.53071	26.68480	109.270	2.914	12383.5
355.0	3552.877	-73.73403	26.47611	26.62998	109.362	2.608	12520.8
360.0	3553.321	-73.55819	26.42065	26.57429	109.454	2.312	12660.6
365.0	3553.717	-73.38055	26.36430	26.51771	109.546	2.029	12802.8
370.0	3554.067	-73.20110	26.30705	26.46023	109.639	1.756	12947.1
375.0	3554.371	-73.01981	26.24889	26.40184	109.734	1.498	13093.3
380.0	3554.630	-72.83666	26.18980	26.34250	109.828	1.251	13241.9
385.0	3554.847	-72.65163	26.12976	26.28221	109.924	1.014	13392.8
390.0	3555.020	-72.46469	26.06875	26.22095	110.021	0.787	13546.0
395.0	3555.153	-72.27583	26.00675	26.15870	110.117	0.571	13701.5
400.0	3555.245	-72.08501	25.94375	26.09544	110.214	0.363	13859.3
405.0	3555.298	-71.89222	25.87973	26.03116	110.311	0.169	14019.5
410.0	3555.313	-71.69742	25.81468	25.96583	110.409	-0.017	14182.3
415.0	3555.291	-71.50059	25.74856	25.89944	110.508	-0.192	14347.3
420.0	3555.233	-71.30170	25.68136	25.83196	110.607	-0.358	14515.2
425.0	3555.141	-71.10073	25.61305	25.76336	110.706	-0.516	14686.0
430.0	3555.016	-70.89763	25.54362	25.69364	110.807	-0.667	14859.7
435.0	3554.857	-70.69238	25.47305	25.62277	110.908	-0.808	15036.1
440.0	3554.667	-70.48496	25.40130	25.55072	111.009	-0.939	15215.1
445.0	3554.447	-70.27532	25.32835	25.47746	111.112	-1.061	15396.7
450.0	3554.198	-70.06344	25.25419	25.40298	111.214	-1.172	15581.1
455.0	3553.923	-69.84931	25.17879	25.32726	111.318	-1.273	15768.1

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LØNG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
460.0	3553.622	-69.63287	25.10213	25.25027	111.420	-1.366	15957.6
465.0	3553.297	-69.41412	25.02418	25.17199	111.525	-1.447	16149.9
470.0	3552.950	-69.19301	24.94492	25.09238	111.630	-1.519	16345.5
475.0	3552.584	-68.96951	24.86432	25.01144	111.736	-1.583	16543.6
480.0	3552.198	-68.74359	24.78235	24.92911	111.842	-1.639	16745.3
485.0	3551.796	-68.51522	24.69898	24.84538	111.950	-1.686	16950.4
490.0	3551.378	-68.28436	24.61419	24.76021	112.059	-1.726	17158.9
495.0	3550.946	-68.05096	24.52793	24.67358	112.168	-1.758	17371.1
500.0	3550.501	-67.81499	24.44019	24.58545	112.277	-1.785	17587.5
505.0	3550.045	-67.57640	24.35094	24.49580	112.386	-1.804	17807.6
510.0	3549.579	-67.33516	24.26013	24.40459	112.497	-1.813	18030.8
515.0	3549.106	-67.09122	24.16774	24.31179	112.608	-1.814	18258.4
520.0	3548.627	-66.84454	24.07372	24.21735	112.720	-1.808	18489.6
525.0	3548.146	-66.59508	23.97806	24.12126	112.831	-1.793	18725.3
530.0	3547.664	-66.34280	23.88071	24.02347	112.944	-1.769	18965.0
535.0	3547.183	-66.08764	23.78164	23.92395	113.057	-1.738	19208.5
540.0	3546.706	-65.82958	23.68081	23.82267	113.170	-1.697	19456.9
545.0	3546.236	-65.56855	23.57818	23.71957	113.284	-1.648	19709.8
550.0	3545.774	-65.30452	23.47372	23.61463	113.399	-1.591	19967.3
555.0	3545.324	-65.03742	23.36738	23.50780	113.514	-1.526	20230.1
560.0	3544.888	-64.76722	23.25911	23.39903	113.630	-1.454	20497.8
565.0	3544.468	-64.49385	23.14888	23.28830	113.746	-1.373	20770.7
570.0	3544.069	-64.21726	23.03664	23.17554	113.863	-1.284	21049.5
575.0	3543.693	-63.93740	22.92235	23.06071	113.980	-1.188	21334.0
580.0	3543.342	-63.65420	22.80596	22.94377	114.098	-1.084	21624.3
585.0	3543.020	-63.36760	22.68740	22.82466	114.217	-0.973	21921.3
590.0	3542.730	-63.07756	22.56665	22.70333	114.337	-0.853	22224.2
595.0	3542.476	-62.78399	22.44364	22.57974	114.457	-0.726	22533.7
600.0	3542.260	-62.48684	22.31832	22.45383	114.577	-0.591	22850.1
605.0	3542.088	-62.18603	22.19064	22.32553	114.697	-0.448	23173.6
610.0	3541.963	-61.88151	22.06054	22.19480	114.820	-0.299	23504.8
615.0	3541.888	-61.57319	21.92796	22.06158	114.941	-0.142	23843.9
620.0	3541.867	-61.26099	21.79282	21.92579	115.065	0.022	24191.4

S-IV STAGE GUIDANCE CUTOFF

621.375	3541.871	-61.17447	21.75521	21.88800	115.099	0.068	24288.8
625.0	3541.889	-60.94599	21.65556	21.78786	115.195	0.073	24297.6
630.0	3541.915	-60.63142	21.51754	21.64916	115.327	0.075	24297.6

TABLE XIX
GEOGRAPHIC COORDINATES

TIME SEC	EC DIST NM	LONG DEG	GC LAT DEG	LAT DEG	VEL-AZ DEG	VEL-ELEV DEG	EF VEL FT/S
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INSERTION

631.375	3541.922	-60.54502	21.47947	21.61090	115.363	0.075	24297.6
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TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
FIRST MOTION							
0.060	1341.6	0.	90.000	0.014	0.303	-0.	106
LIFTOFF SIGNAL							
0.260	1341.7	0.081	89.999	0.014	0.308	-0.	106
1.0	1341.7	0.392	89.997	0.016	0.401	0.000	110
2.0	1341.8	0.833	89.996	0.022	0.738	0.000	124
3.0	1341.9	1.293	89.995	0.030	1.347	-0.000	149
4.0	1342.1	1.769	89.993	0.039	2.255	-0.000	184
5.0	1342.4	2.259	89.991	0.049	3.484	-0.000	231
6.0	1342.8	2.762	89.988	0.059	5.053	-0.000	290
7.0	1343.2	3.276	89.984	0.069	6.982	-0.000	361
8.0	1343.8	3.801	89.979	0.080	9.291	-0.000	444
9.0	1344.5	4.338	89.974	0.091	12.002	-0.001	538
10.0	1345.3	4.886	89.968	0.102	15.135	-0.001	647
11.0	1346.2	5.446	89.962	0.114	18.714	-0.001	768
12.0	1347.3	6.017	89.956	0.125	22.669	-0.001	902
13.0	1348.5	6.601	89.951	0.137	27.032	-0.002	1050
14.0	1349.9	7.195	89.947	0.149	31.881	-0.002	1212
15.0	1351.5	7.802	89.945	0.162	37.234	-0.003	1388
16.0	1353.4	8.418	89.945	0.175	43.108	-0.003	1579
17.0	1355.5	9.045	89.947	0.188	49.521	-0.004	1785
18.0	1358.0	9.682	89.952	0.202	56.480	-0.004	2005
19.0	1360.9	10.326	89.960	0.216	63.992	-0.005	2241
20.0	1364.2	10.978	89.972	0.230	72.061	-0.005	2493
21.0	1368.0	11.636	89.987	0.244	80.687	-0.006	2761
22.0	1372.4	12.298	90.006	0.259	89.868	-0.006	3045
23.0	1377.5	12.964	90.030	0.274	99.601	-0.006	3346
24.0	1383.2	13.632	90.059	0.290	109.876	-0.006	3663
25.0	1389.6	14.301	90.093	0.305	120.726	-0.005	3997
26.0	1396.8	14.970	90.132	0.321	132.067	-0.004	4349
27.0	1404.9	15.637	90.176	0.338	143.913	-0.003	4719
28.0	1413.7	16.302	90.226	0.354	156.308	-0.001	5107
29.0	1423.5	16.962	90.281	0.372	169.244	0.002	5513
30.0	1434.0	17.617	90.340	0.389	182.655	0.006	5937

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DFG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
31.0	1445.3	18.264	90.405	0.407	196.487	0.011	6381
32.0	1457.5	18.901	90.475	0.425	210.894	0.016	6843
33.0	1470.5	19.530	90.548	0.443	225.826	0.023	7325
34.0	1484.3	20.150	90.625	0.463	241.360	0.031	7826
35.0	1498.9	20.762	90.707	0.482	257.579	0.041	8348
36.0	1514.3	21.362	90.796	0.503	274.757	0.051	8889
37.0	1530.5	21.951	90.896	0.522	289.663	0.064	9451
38.0	1547.5	22.526	91.006	0.541	304.164	0.078	10033
39.0	1565.5	23.089	91.124	0.561	319.914	0.093	10636
40.0	1584.3	23.637	91.245	0.583	338.367	0.111	11261
41.0	1603.9	24.173	91.368	0.606	356.669	0.130	11907
42.0	1624.3	24.694	91.493	0.629	375.054	0.152	12574
43.0	1645.6	25.198	91.622	0.653	393.767	0.175	13264
44.0	1667.7	25.683	91.754	0.676	411.777	0.202	13976
45.0	1690.6	26.150	91.887	0.700	429.504	0.230	14710
46.0	1714.5	26.597	92.020	0.724	446.812	0.261	15466
47.0	1739.4	27.025	92.151	0.749	464.439	0.295	16245
48.0	1765.0	27.434	92.281	0.777	484.359	0.331	17047
49.0	1791.5	27.825	92.414	0.804	503.089	0.370	17871
50.0	1818.8	28.197	92.552	0.834	523.577	0.413	18719
51.0	1847.0	28.550	92.696	0.863	542.702	0.458	19591
52.0	1875.7	28.886	92.843	0.891	558.166	0.507	20485
53.0	1905.0	29.205	92.989	0.925	580.017	0.559	21403
54.0	1934.5	29.501	93.135	0.959	601.658	0.615	22344
55.0	1964.1	29.771	93.282	0.992	619.575	0.674	23308

MACH ZNE

55.245	1971.4	29.832	93.319	1.000	623.217	0.689	23547
56.0	1994.0	30.008	93.430	1.023	633.143	0.737	24294
57.0	2024.2	30.212	93.580	1.055	646.329	0.804	25302
58.0	2055.0	30.385	93.731	1.085	656.161	0.874	26331
59.0	2086.7	30.533	93.883	1.116	664.568	0.949	27381
60.0	2119.2	30.665	94.035	1.148	672.675	1.027	28452
61.0	2152.6	30.790	94.186	1.182	681.832	1.110	29543
62.0	2186.8	30.911	94.337	1.222	695.439	1.197	30655
63.0	2221.8	31.029	94.491	1.264	709.226	1.289	31789
64.0	2257.7	31.140	94.653	1.305	719.690	1.386	32946
65.0	2294.6	31.240	94.826	1.346	726.835	1.487	34125

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
66.0	2332.7	31.327	95.010	1.390	734.914	1.594	35326
67.0	2371.9	31.401	95.202	1.434	740.980	1.705	36550
68.0	2412.3	31.465	95.395	1.483	748.154	1.822	37798
69.0	2453.9	31.519	95.582	1.531	752.359	1.945	39069
70.0	2495.6	31.565	95.757	1.585	759.560	2.074	40363
71.0	2540.6	31.599	95.920	1.640	764.304	2.208	41682
72.0	2585.8	31.619	96.077	1.698	768.025	2.349	43025

MAXIMUM DYNAMIC PRESSURE

73.000	2632.4	31.626	96.234	1.756	768.670	2.496	44393
74.0	2680.2	31.621	96.391	1.808	759.961	2.650	45786
75.0	2729.4	31.609	96.547	1.863	751.905	2.810	47204
76.0	2779.8	31.591	96.701	1.923	744.656	2.978	48647
77.0	2831.5	31.571	96.848	1.978	730.456	3.153	50116
78.0	2884.3	31.551	96.988	2.029	712.214	3.335	51611
79.0	2933.3	31.530	97.125	2.090	699.128	3.525	53133
80.0	2993.6	31.504	97.263	2.145	680.619	3.723	54684
81.0	3050.2	31.472	97.402	2.205	663.032	3.929	56262
82.0	3108.2	31.433	97.540	2.262	642.552	4.143	57868
83.0	3167.6	31.387	97.675	2.309	616.561	4.365	59503
84.0	3223.4	31.334	97.808	2.360	592.282	4.597	61166
85.0	3290.7	31.276	97.939	2.401	563.759	4.837	62860
86.0	3354.3	31.214	98.069	2.463	544.927	5.086	64583
87.0	3419.3	31.149	98.199	2.508	518.748	5.344	66336
88.0	3485.7	31.080	98.330	2.563	497.212	5.613	68119
89.0	3553.4	31.008	98.459	2.611	473.518	5.891	69934
90.0	3622.6	30.931	98.587	2.684	458.410	6.179	71781
91.0	3693.2	30.848	98.713	2.748	439.529	6.477	73659
92.0	3765.1	30.761	98.836	2.810	420.151	6.786	75570
93.0	3838.5	30.668	98.957	2.867	399.488	7.105	77511
94.0	3913.3	30.569	99.075	2.918	377.705	7.436	79484
95.0	3989.5	30.466	99.195	2.983	360.345	7.777	81489
96.0	4067.0	30.362	99.315	3.072	348.273	8.131	83528
97.0	4146.0	30.254	99.435	3.153	333.636	8.496	85599
98.0	4225.5	30.143	99.550	3.227	317.408	8.872	87704
99.0	4303.4	30.030	99.664	3.269	294.535	9.261	89842
100.0	4391.7	29.913	99.776	3.340	277.011	9.663	92014
101.0	4474.6	29.792	99.886	3.413	260.042	10.077	94219

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
102.0	4563.0	29.668	99.994	3.486	243.650	10.504	96460
103.0	4650.8	29.541	100.100	3.561	227.811	10.944	98734
104.0	4740.1	29.411	100.203	3.636	212.565	11.398	101043
105.0	4830.9	29.281	100.304	3.712	197.929	11.866	103387
106.0	4923.2	29.150	100.402	3.789	184.425	12.347	105765
107.0	5017.1	29.018	100.499	3.865	172.763	12.843	108180
108.0	5112.6	28.884	100.595	3.941	161.645	13.353	110630
109.0	5209.7	28.748	100.689	4.018	151.066	13.877	113115
110.0	5308.5	28.611	100.782	4.096	141.009	14.417	115637
111.0	5408.9	28.472	100.874	4.174	131.490	14.972	118196
112.0	5511.1	28.329	100.964	4.253	122.491	15.542	120791
113.0	5614.9	28.186	101.052	4.332	113.989	16.129	123422
114.0	5720.5	28.041	101.138	4.413	105.972	16.731	126091
115.0	5827.9	27.897	101.222	4.494	98.431	17.350	128797
116.0	5937.2	27.753	101.305	4.577	91.385	17.986	131540
117.0	6048.3	27.610	101.387	4.660	84.768	18.639	134322
118.0	6161.2	27.468	101.468	4.745	78.588	19.309	137142
119.0	6275.1	27.326	101.546	4.832	72.821	19.996	140001
120.0	6392.9	27.182	101.622	4.921	67.443	20.702	142899
121.0	6511.8	27.037	101.696	5.011	62.441	21.425	145837
122.0	6632.7	26.891	101.770	5.105	57.799	22.168	148814
123.0	6755.7	26.745	101.843	5.202	53.484	22.929	151831
124.0	6880.9	26.598	101.916	5.303	49.489	23.709	154889
125.0	7003.3	26.452	101.989	5.409	45.786	24.510	157988
126.0	7127.9	26.305	102.061	5.522	42.377	25.330	161127
127.0	7260.8	26.157	102.131	5.654	39.422	26.170	164308
128.0	7404.1	26.007	102.199	5.793	36.621	27.031	167530
129.0	7540.8	25.856	102.266	5.937	33.967	27.914	170794
130.0	7680.2	25.703	102.330	6.087	31.451	28.818	174101
131.0	7822.2	25.549	102.394	6.244	29.067	29.743	177450
132.0	7967.0	25.393	102.458	6.408	26.810	30.692	180841
133.0	8114.6	25.235	102.521	6.578	24.672	31.663	184275
134.0	8265.0	25.075	102.583	6.755	22.649	32.658	187753
135.0	8418.4	24.914	102.646	6.940	20.739	33.676	191276
136.0	8574.6	24.754	102.707	7.132	18.940	34.720	194837
137.0	8734.3	24.592	102.770	7.331	17.245	35.788	198442
138.0	8895.9	24.433	102.832	7.538	15.652	36.882	202093
139.0	9067.9	24.280	102.891	7.753	14.156	38.001	205788
140.0	9232.4	24.134	102.952	7.976	12.758	39.147	209532
141.0	9403.7	23.996	103.010	8.208	11.451	40.320	213324

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
INBOARD ENGINE CUTOFF							
141.540	9500.6	23.926	103.042	8.337	10.783	40.964	215393
142.0	9562.9	23.873	103.064	8.429	10.187	41.519	217168
143.0	9650.2	23.737	103.099	8.582	8.877	42.737	221037
144.0	9734.6	23.604	103.135	8.735	7.703	43.969	224921
145.0	9819.0	23.473	103.170	8.891	6.661	45.215	228818
146.0	9904.6	23.345	103.206	9.050	5.741	46.474	232729
147.0	9990.5	23.219	103.241	9.211	4.930	47.747	236653
OUTBOARD ENGINE CUTOFF							
147.640	10045.9	23.141	103.263	9.317	4.464	48.570	239172
148.0	10065.2	23.095	103.273	9.365	4.208	49.035	240591
149.0	10050.0	22.958	103.288	9.431	3.514	50.328	244520
150.0	10050.3	22.817	103.302	9.497	2.929	51.621	248422
155.0	10057.5	22.133	103.382	9.898	1.160	58.094	267586
160.0	10100.8	21.471	103.462	10.052	0.421	64.622	286271
165.0	10150.8	20.823	103.546	9.872	0.148	71.213	304502
170.0	10203.9	20.177	103.638	9.522	0.056	77.870	322290
175.0	10250.4	19.501	103.779	9.081	0.023	84.595	339621
180.0	10317.0	18.814	103.926	8.659	0.010	91.391	356469
185.0	10373.3	18.133	104.062	8.054	0.005	98.258	372828
190.0	10441.6	17.462	104.194	7.516	0.003	105.198	388702
195.0	10503.0	16.800	104.317	6.828	0.001	112.212	404092
200.0	10576.8	16.154	104.437	6.239	0.001	119.301	419005
205.0	10643.1	15.522	104.551	5.806	0.001	126.465	433450
210.0	10722.4	14.905	104.661	5.475	0.000	133.705	447432
215.0	10798.9	14.301	104.765	5.213	0.000	141.023	460958
220.0	10877.8	13.709	104.867	5.002	0.000	148.418	474033
225.0	10950.5	13.129	104.967	4.828	0.000	155.893	486662
230.0	11043.8	12.560	105.064	4.709	0.000	163.448	498851
235.0	11130.8	12.002	105.159	4.625	0.000	171.084	510602
240.0	11219.6	11.455	105.253	4.554	0.000	178.803	521919
245.0	11311.4	10.924	105.345	4.517	0.000	186.605	532808
250.0	11405.4	10.405	105.438	4.496	0.000	194.491	543274
255.0	11500.9	9.899	105.529	4.478	0.000	202.463	553324

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DFG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
260.0	11599.1	9.407	105.620	4.475	0.000	210.522	562965
265.0	11699.4	8.928	105.711	4.481	0.000	218.667	572201
270.0	11801.7	8.462	105.801	4.490	0.000	226.901	581037
275.0	11905.2	8.007	105.893	4.502	0.000	235.225	589482
280.0	12012.7	7.569	105.984	4.516	0.000	243.639	597539
285.0	12121.1	7.143	106.076	4.533	0.000	252.144	605217
290.0	12231.9	6.726	106.168	4.552	0.000	260.742	612520
295.0	12344.5	6.323	106.260	4.573	0.000	269.433	619454
300.0	12459.2	5.930	106.355	4.598	0.000	278.220	626024
305.0	12577.9	5.554	106.448	4.630	0.000	287.104	632236
310.0	12694.2	5.188	106.542	4.663	0.000	296.081	638100
315.0	12814.9	4.832	106.638	4.698	0.000	305.159	643618
320.0	12937.5	4.486	106.734	4.734	0.000	314.336	648797
325.0	13062.3	4.152	106.831	4.772	0.000	323.614	653640
330.0	13189.4	3.825	106.928	4.811	0.000	332.995	658153
335.0	13318.6	3.510	107.027	4.853	0.000	342.479	662340
340.0	13450.0	3.207	107.126	4.895	0.000	352.069	666209
345.0	13583.5	2.914	107.226	4.940	0.000	361.766	669762
350.0	13719.1	2.630	107.327	4.985	0.000	371.571	673008
355.0	13856.9	2.356	107.428	5.033	0.000	381.486	675951
360.0	13997.0	2.091	107.530	5.082	0.000	391.512	678597
365.0	14139.4	1.837	107.632	5.133	0.000	401.651	680950
370.0	14283.9	1.592	107.735	5.185	0.000	411.905	683019
375.0	14430.3	1.359	107.840	5.238	0.000	422.276	684808
380.0	14579.0	1.136	107.943	5.294	0.000	432.764	686327
385.0	14729.9	0.922	108.049	5.350	0.000	443.371	687582
390.0	14883.2	0.716	108.155	5.409	0.000	454.100	688580
395.0	15039.6	0.520	108.262	5.469	0.000	464.953	689323
400.0	15195.4	0.331	108.368	5.530	0.000	475.929	689821
405.0	15356.5	0.154	108.476	5.593	0.000	487.033	690081
410.0	15519.3	-0.015	108.583	5.658	0.000	498.265	690109
415.0	15684.1	-0.176	108.691	5.725	0.000	509.628	689913
420.0	15851.9	-0.328	108.801	5.793	0.000	521.124	689499
425.0	16022.5	-0.473	108.910	5.863	0.000	532.754	688875
430.0	16195.9	-0.612	109.020	5.935	0.000	544.522	688045
435.0	16372.2	-0.742	109.131	6.009	0.000	556.430	687014
440.0	16550.9	-0.863	109.243	6.084	0.000	568.479	685791
445.0	16732.3	-0.976	109.355	6.161	0.000	580.672	684384
450.0	16916.5	-1.080	109.468	6.240	0.000	593.012	682802
455.0	17103.2	-1.174	109.582	6.321	0.000	605.499	681057

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
460.0	17292.4	-1.261	109.694	6.403	0.000	618.138	679156
465.0	17484.4	-1.337	109.809	6.488	0.000	630.929	677109
470.0	17679.7	-1.404	109.924	6.574	0.000	643.875	674930
475.0	17877.5	-1.465	110.040	6.662	0.000	656.980	672626
480.0	18079.0	-1.518	110.157	6.752	0.000	670.244	670207
485.0	18283.8	-1.563	110.275	6.844	0.000	683.672	667685
490.0	18492.0	-1.601	110.394	6.937	0.000	697.267	665066
495.0	18703.8	-1.632	110.513	7.034	0.000	711.030	662360
500.0	18920.0	-1.659	110.632	7.132	0.000	724.965	659576
505.0	19139.8	-1.679	110.752	7.232	0.000	739.076	656720
510.0	19362.7	-1.688	110.872	7.335	0.000	753.366	653806
515.0	19590.0	-1.691	110.994	7.439	0.000	767.838	650846
520.0	19820.9	-1.687	111.116	7.546	0.000	782.494	647855
525.0	20056.3	-1.674	111.238	7.655	0.000	797.339	644842
530.0	20295.7	-1.653	111.361	7.765	0.000	812.375	641823
535.0	20539.0	-1.625	111.484	7.878	0.000	827.607	638812
540.0	20787.1	-1.588	111.608	7.993	0.000	843.038	635823
545.0	21039.8	-1.544	111.733	8.110	0.000	858.671	632872
550.0	21297.0	-1.492	111.858	8.229	0.000	874.510	629973
555.0	21559.6	-1.432	111.984	8.351	0.000	890.560	627142
560.0	21827.1	-1.365	112.111	8.474	0.000	906.824	624395
565.0	22099.8	-1.290	112.238	8.599	0.000	923.307	621750
570.0	22378.3	-1.208	112.365	8.727	0.000	940.013	619224
575.0	22662.6	-1.119	112.494	8.857	0.000	956.946	616835
580.0	22952.8	-1.021	112.623	8.988	0.000	974.111	614602
585.0	23249.6	-0.917	112.753	9.122	0.000	991.514	612541
590.0	23552.3	-0.805	112.883	9.258	0.000	1009.158	610674
595.0	23861.7	-0.686	113.014	9.396	0.000	1027.049	609022
600.0	24178.0	-0.559	113.146	9.535	0.000	1045.192	607606
605.0	24501.3	-0.424	113.277	9.676	0.000	1063.593	606451
610.0	24832.4	-0.283	113.411	9.819	0.000	1082.256	605577
615.0	25171.4	-0.135	113.544	9.964	0.000	1101.188	605007
620.0	25513.8	0.021	113.678	10.111	0.000	1120.396	604764

S-IV STAGE GUIDANCE CUTOFF

621.375	25615.2	0.065	113.716	10.152	0.000	1125.726	604759
625.0	25624.9	0.070	113.806	10.155	0.000	1139.814	604784
630.0	25624.8	0.071	113.930	10.155	0.000	1159.246	604824

TABLE XX
SPECIAL TRAJECTORY DEPENDENT PARAMETERS

TIME SEC	SF VEL FT/S	FLT-PATH DEG	HEAD DEG	MACH	DYN-PRES LB/FT SQ	RANGE NM	ALTITUDE FT
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INSERTION

631.375	25624.8	0.071	113.964	10.155	0.000	1164.590	604835
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APPENDIX

DEFINITION OF SYMBOLS

<u>Symbol</u>	<u>Definition</u>
XE, YE, ZE	Position, velocity and acceleration components in the <u>Earth-Fixed Cartesian Coordinate System</u> . The origin of this system is the projection of the center of gravity of the complete vehicle at first motion onto the Fischer Ellipsoid of 1960. The X-Z plane is tangent to the reference ellipsoid at the origin of the coordinate system. The positive X-axis is oriented in the flight azimuth direction, 105° E of N. The Y-axis is normal to the X-Z plane and is positive above the origin. The Z-axis is normal to the X-Y plane and is in a right hand relation to the X-Y axes with the positive direction 195° E of N. The origin of this earth-fixed system rotates with an angular velocity identical to that of the earth. The earth-fixed coordinate system is shown in Figure 20.
XSP, YSP, ZSP	Position, velocity and acceleration components in the <u>Space-Fixed Ephemeris Coordinate System</u> . The origin of this system is located at the geocentric center of the earth. The Z-axis points north along the earth's axis of rotation (through the north pole). The X-Y plane is coincident with the equatorial plane. The X-axis points through the vernal equinox. The reference equinox and equator of date for the epoch of midnight or zero hours on the day of launch. The Y-axis is normal to
DXE, DYE, DZE	
DDXE, DDYE, DDZE	
DXSP, DYSP, DZSP	
DDXSP, DDYSP, DDZSP	

DEFINITION OF SYMBOLS (CONTD)

<u>Symbol</u>	<u>Definition</u>
	the X-Z plane and in a right hand relation to the X-, Z- axes. The direction of the coordinate axes remain fixed in space although the origin continues to move with the center of the earth. The space-fixed ephemeris coordinate system is shown in Figure 20.
E. C. DIST	Position of vehicle in the <u>Geographic Coordinate System</u> . Position in this system is defined by the radius vector from the vehicle to the geocentric center of the earth (E. C. DIST), geocentric latitude (G. C. LAT) and longitude (LONG). A subvehicle point is defined as the intersection of the reference ellipsoid and the radius vector from the vehicle to the center of the earth. The geocentric latitude and longitude refer to the subvehicle point.
LONG	<u>Geocentric latitude</u> is the angle between the radius vector and the equatorial plane, positive north of the equator.
G. C. LAT	<u>Longitude</u> is the angle between the projection of the radius vector into the equatorial plane and the Greenwich meridian, measured positive east of the Greenwich meridian.
E. F. VEL	Earth-fixed velocity of vehicle in the <u>Geographic Coordinate System</u> . Velocity in this system is given in terms of azimuth (VEL-AZ), elevation (VEL-ELEV), and magnitude of the velocity vector (E. F. VEL). Azimuth is the angle between the projection of the velocity vector into the local horizontal
VEL-AZ	
VEL-ELEV	

DEFINITIONS OF SYMBOLS (CONTD)

<u>Symbol</u>	<u>Definition</u>
E. F. VEL	plane and the north direction in this plane. Elevation is the angle between the velocity vector and the local horizontal plane. The local horizontal plane is defined as the plane perpendicular to the radius vector from the vehicle to the geocentric center of the earth. The geographic coordinate system is shown in Figure 20.
S. F. VEL	Space-fixed velocity of vehicle in the <u>Geographic Coordinate System</u> .
FLT-PATH	Velocity is given in terms of flight-path angle (FLT-PATH), heading angle (HEAD), and magnitude of the velocity vector (S. F. VEL). The flight-path angle is the angle between the space-fixed velocity vector and the plane normal to the radius vector from the vehicle to the geocentric center of the earth, measured positive upward from this plane. The heading angle is measured positive clockwise from north to the projection of the space-fixed velocity vector in the plane normal to the radius vector.
HEAD	
LAT	Geodetic latitude of vehicle
MACH	Mach number
DYN PRES	Dynamic Pressure
ALTITUDE	Distance from the subvehicle point to the center of gravity of the vehicle measured along the radius vector from the vehicle to the geocentric center of the earth.

DEFINITIONS OF SYMBOL (CONTD)

<u>Symbol</u>	<u>Definition</u>
RANGE	Surface range measured along a spherical earth from the launch site to the subvehicle point.
Mean Sidereal Time (θ)	The <u>mean sidereal time</u> is the angle between the mean vernal equinox and the Greenwich meridian for the epoch of midnight on the day of launch.
Orbital Element	The <u>Orbital Element System</u> is defined by six osculating elements of the two body ellipse with the reference body being determined by the body constants used, normally those of the earth. The elements are the semi-major axis of the ellipse; the eccentricity; the right ascension of the ascending node (Point of intersection of the orbital plane and earth equatorial plane); the inclination of the orbital plane to the earth equatorial plane; the argument of perigee or the angle between the ascending node and the perigee; the true anomaly or the angle between the perigee point and the satellite point. The various orbital elements are shown in Figure 20.

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December 1, 1964

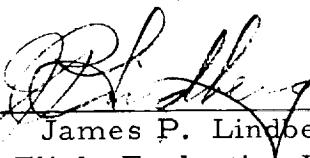
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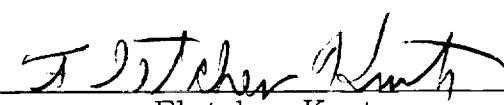
SATURN SA-7/BP-15 POSTFLIGHT TRAJECTORY

By Gerald R. Riddle and Robert H. Benson

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Fletcher Kurtz
Chief, Operations Studies Branch



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Chief, Flight Evaluation and
Operations Studies Division



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